For PECK, C.H.

The University of the State of New York
State Museum, July 15, 1919

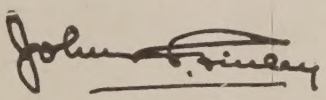
Dr John H. Finley
President of the University

SIR: I have the honor to communicate to you herewith and to recommend for publication, as a Bulletin of the State Museum, the Director's Annual Report for the year 1918.

Very respectfully yours
JOHN M. CLARKE
Director

THE UNIVERSITY OF THE STATE OF NEW YORK
OFFICE OF THE PRESIDENT

Approved for publication this 18th day of December 1919



President of the University

Reconstruction of the Sterlingbush calcite cave

New York State Museum Bulletin

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The University of the State of New York
New York State Museum

JOHN M. CLARKE, Director

FIFTEENTH REPORT OF THE DIRECTOR OF THE STATE MUSEUM AND SCIENCE DEPARTMENT

INCLUDING THE SEVENTY-SECOND REPORT OF THE STATE MUSEUM, THE THIRTY-EIGHTH REPORT OF THE STATE GEOLOGIST AND THE REPORT OF THE STATE PALEONTOLOGIST FOR 1918

Regents Committee on the State Museum:

Charles B. Alexander M.A. LL.D. Litt.D., Tuxedo
Herbert L. Bridgman M.A., Brooklyn
Walter Guest Kellogg B.A., Ogdensburg

INTRODUCTION

This report covers all divisions of the scientific operations and museum work under the supervision of The University of the State of New York and has reference to the progress made therein during the fiscal year 1917–18. It constitutes the seventy-second consecutive annual report of the State Museum, the thirty-eighth annual report of the State Geologist (consecutive since 1881) and the report of the State Paleontologist for 1918. It is introductory to all memoirs and bulletins issued by this Department during the year named.

The subjects presented in this report are considered under the following captions:

I Legal Status and Scope of the State Museum
II Present Condition of the Museum
III The Scientific Reservations under Control of the Museum
IV Department Publications
V Report on the Geological Survey
VI Report of the State Botanist
VII Report of the State Entomologist
VIII Report of the Division of Zoology
IX Report of the Division of Archeology and Ethnology
X Staff of the Department
XI Scientific Papers
XII Appendixes (to be continued in subsequent volumes)

I

LEGAL STATUS AND SCOPE OF THE STATE MUSEUM

The broad scope of the State Museum was clearly and succinctly defined in the Education Law (as amended in 1910) under article 3, which relates to the objects and functions of the University. Section 54 of that law reads as follows: "All scientific specimens and collections, *works of art, objects of historic interest* and similar property appropriate to a general museum, if owned by the State and not placed in other custody by a specific law, *shall constitute the State Museum.* . . The State Museum shall include the work of the State Geologist and Paleontologist, the State Botanist and the State Entomologist, who, with their assistants, shall be included in the scientific staff of the State Museum."

This definition of scope is clear. It is the specific expression of the intent of the people of the State to constitute and maintain not alone a state museum of science, but a state museum of art, a state museum of history and a state museum which may depict any other field of civic and educational concern which in the judgment of the Regents of the University, would be justified by public interest. The spirit of the law where its sentences bear upon the creation of a museum of art and a museum of history is so obvious as to be constructively a command. The wish of the people and the desire of the Board in regard to this expansion of the actual museum nearer to the ideal of the museum expressed in the law have become a matter of record. It is then to be understood that the existing science museum of the State represents the development of only one phase of what should be, and what within the implied intention of the law is to be, the State Museum.

II

PRESENT CONDITION OF THE MUSEUM

Improved lighting. The original construction of the overhead lighting system of the Museum has proved so inadequate to the demands that it has been necessary to instal a more effective arrangement of electric illumination in certain of the halls. The east and west ends of the main halls, allotted to paleontology and mineralogy respectively, and which are separated into panels where the lighting has been thus insufficient, have been greatly helped by this substitution and it is now planned to extend this supplementary lighting to the panels which cover the entrance hall and the foyer.

Attendance. The Museum is still visited by thousands. For three years Sunday afternoon opening has been maintained, but the question has been raised as to the wisdom of continuing this procedure. The Sunday visitors, unlike those of the week days, are mostly from the city of Albany, people who have had abundant and repeated opportunity to examine the collections, and since the novelty of the place, to these citizens, has grown less, the crowd drawn together on these occasions are less disposed to make their visits for study and instruction than for indiscriminate meeting and parade. Herein lies a danger against which the Museum must be safeguarded.

Discoloration of the façade of the Education Building. Ever since its erection the marble colonnade of the Education Building has shown increasing discoloration from the southeast corner westward along the Washington avenue front. This discoloration is too obviously irregular in its distribution to be a pleasing mellowing of the marble. It is deepest at the corner referred to, and in the front grooves of the columns, and decreases in intensity away from this point along the colonnade. The result is that the building has yellowed at one end and on the front surfaces of the columns, producing these unpleasing contrasts which are obviously becoming more intense. The causes of this discoloration would be reasonably clear to any scientific man who understood the meteorological and industrial conditions of Albany, but to have the matter investigated rationally in the hope of finding the cause and possible cure, the mineralogist of the Museum, Mr Gardner, has carried out a series of intimate analyses, chemical and microscopic, the results of which may here be briefly summarized thus:

1 Immense clouds of coal smoke are constantly generated on the river front near and opposite the foot of State street. It is stated

that in the round house at Rensselaer alone forty locomotives are fired every day.

2 These smoke clouds contain soot (free carbon) and the oxides of sulphur and iron, both of which are derived from iron-pyrites, a common impurity in all soft coal.

3 Prevailing south and east winds at all times of the year sweep these fumes and soot up the State street canyon, against the Capitol whence they are deflected against the east corner of the Education Building and from here up the street.

4 The first visible effect of this attack is the deposit of soot which has darkened the surface.

5 Further discoloration is caused by the deposit of iron oxide in the coal gas.

6 The sulphuric acid in the gas attacks the carbonate of lime, of which the marble is composed, and alters it to a sulphate of lime or gypsum. This change, on well-exposed surfaces, appears now to have extended inward to the depth of one-sixteenth of an inch.

It is thought that the condition may be remedied by the removal of the discolored parts by sand, holystone, or wire brush, and that the surface thereafter be protected by the application of a liquid preservative, though at present we are not in position to recommend any such preparation now on the market.

The front of the Capitol is blackened and soot-smeared by the same causes, but being of granite it is very much less, perhaps imperceptibly, affected by the acids in the air. The dripping water has helped to spread this soot and so increased the evil appearance of the building.

The report on this examination is given elsewhere in its entirety. It is a precise technical analysis of the conditions and the determination of the agencies at work will be, it is thought, of service in the new construction now proposed for the Capitol section.

Increases and changes in the Museum collections. A collection of Indian relics from the old Seneca village of Totiacton and from other habitation and burial sites of western New York, brought together by Mr Alvin H. Dewey of Rochester, has been acquired for the archeology division by the generous assistance of Mrs Frederick F. Thompson, and some detailed account of it is given in the report of the Archeologist.

The Dewey collection is among the last and largest of the assemblages of Iroquois relics from western New York and it has added many fine and some unique articles to the Museum, which has now become the depositary of the most extensive series of

remains of the Iroquois culture. It is increasingly difficult to obtain true ethnological material of early Indian days, the simple furnishings of the everyday domestic life of the Iroquois. Little now of the kind is left among the older families, much has fallen into decay and the rest pretty largely gathered up. A small collection of such ethnological material has, however, been obtained from Mrs Laura Doctor of the Tonawanda reservation, for which the Museum is again indebted to the interest of Mrs Thompson.

During most of the year Mr Bishop and Mr Paladin of the zoology division were absent, the former on navy service, the latter in the army. In consequence little progress could be made in increasing or improving these collections. A very effective installation has been made of a group of eight timber-wolves in early winter surroundings, and also of nesting and fledgling flickers in a tree section ten feet high. Plans have been drawn for a case of American beaver which will give a fair and full exposition of the activities of a beaver family, not only in dam-building but in house construction. These plans call for a large group requiring much detail in its preparation.

The exhibited part of the Arnold bird-egg collection has been increased by the extension of the wall cases in the rotunda corridors so that they have now reached the possible limit, and as now displayed present an impressive appearance. A very large number of duplicates remain in storage. The surroundings of the cases have been improved by the installation of seventy original india ink paintings by Ernest Seton Thompson, forming seven panels.

Restoration of the Sterlingbush calcite grotto. In the year 1906 the members of the geological staff engaged in field work in northern New York discovered a cave in the limestones near Sterlingbush, Lewis county, which was unique and beautiful. Observing a small opening on the face of the quarry and some 20 feet above the quarry floor, examination by ladders and staging revealed a crystal-lined cavern opening out to a few feet in width, running about 40 feet inward and then pinching out. The crystals lined the cavern completely, attached at the sides but on the bottom lying free, and their size was most impressive. Some were immense, probably among the largest ever found, while the greater part of the exposed surface of the cave bore superb crystals, deeply colored of an amethystine violet, and the interstices were filled with clusters of smaller but perfect crystallizations.

It was a great pity that this brilliant grotto preserving crystals in such extraordinary aggregation could not have been preserved

The Helderberg, or Lower Devonian group. Reconstruction of the life forms in natural surroundings.

for the benefit of the people of the State, but its inaccessibility, its deep penetration into the solid mass of rock and the purpose of the quarry owners to cut it away, made it necessary to do what was possible to save the crystals. Not less than ten tons of these were removed and it is some part of these that have been used in the effort to produce, in the halls of the Museum, a replica of the cavern on diminished scale. The intricate and difficult work of restoration and construction in the mineralogy hall, has been accomplished with a very striking effect and the observer is able to get from it a satisfactory impression of the appearance of the cave with its crystallization and glowing colors. The clever disposition of the electric lighting brings out the deep rose shades shown by transmitted light and the amethyst color seen under reflected rays. The plan has been worked out and executed by Noah T. Clarke and Charles P. Heidenrich.

Restorations of invertebrate fossils. The desirability of increasing the number of such restorations of the invertebrate animals of our ancient faunas as will serve to give adequate conceptions of their living form, has made itself so evident that plans have been put into effect for the execution of additional exhibits. Last year an underwater group showing the fauna of the Portage group (Upper Devonian) of western New York was installed and has excited general interest and much expert approval. There has recently been added to the series of reconstructions a group portraying the living form of the marine animals belonging to the seas of the Lower Devonian of eastern New York as exemplified in the region of the Helderberg mountains. A photograph of this group is here inserted with additional illustrations of individual restorations in order to show the detail in which the work has been elaborated. Fortunate provision by a friend of the Museum will probably permit the increase of this series of illustrations of the life of our long past.

New York fishes. The collections have been removed to the walls of the zoology hall, in order to save space, and the present arrangement appears to be very effective. The collection of the food and game fishes is not so extensive as it should be, and there has been good reason to hope for an increase in it through private means. This may be realized; it is much needed as public interest in the fishes is very keen.

Additions from field operations. While materials in all branches of natural history are constantly coming to the Museum, important special additions have been in several directions:

1 An extensive series of fossil Eurypterida from a new horizon in the Salina or Vernon shales at Pittsford, affording fine specimens of species already described and of some heretofore unknown.

2 A special series of natural abrasive materials brought together in the field work of Mr Colony, whose report on this subject has now been printed.

3 An extensive collection of the fossils of the Stafford limestone (Middle Devonian) from LeRoy and Stafford.

The proposed statue of Prof. Joseph Henry. The matter of the creation of a statue of this eminent American, whose earliest experiments on electrical transmission were made in the Albany Academy, became in a proper sense one of the concerns of the State Museum as a result of a duly organized committee for this purpose, of which the President of the University was a member and the Director of the Museum secretary and treasurer. At a public meeting of the National Academy of Sciences held in New York in the autumn of 1915, Prof. Michael I. Pupin, the distinguished electro-mechanician, spoke in such pleasing eulogy of Joseph Henry and his pioneer work in the field of electrics that, at the suggestion of the writer, who was present at the address, he was invited by the President of the University to come to Albany and, the occasion of his visit being fixed, Professor Pupin was tendered a dinner by Regent Charles B. Alexander, chairman of the Museum committee. The dinner was held at the Ten Eyck Hotel May 24, 1916, with the following guests:

Charles B. Alexander, Regent of the University
Martin H. Glynn, Former Governor of New York
Pliny T. Sexton, Chancellor of the University
Dr Albert Vander Veer, Vice Chancellor of the University
John H. Finley, President of the University
John J. Carty, President, National Institute Electrical Engineers
Chester S. Lord, Regent of the University
Francis M. Carpenter, Regent of the University
Abram I. Elkus, Regent of the University
Adelbert Moot, Regent of the University
Walter G. Kellogg, Regent of the University
William Berri, Regent of the University
James Byrne, Regent of the University
Henry P. Warren, Headmaster, Albany Academy
J. Townsend Lansing, President, Albany Institute
John M. Clarke, Director, State Museum

At the close of the dinner, the writer acting as toastmaster, brief addresses were made by Governor Glynn, Doctor Finley, and Doctor

Scytalocrinus. The Helderberg sea-lily as in life.

Detail from the Helderberg group. Nautilus (Gyroceras) attacking a Trilobite (Homalonotus).

Carty, Mr Glynn having special interest in the event because of his part in securing the Flanagan model, and Doctor Carty because of his practical appreciation of Henry's great service. The proposition was formally made to erect in Albany a statue and to this suggestion Mr Pupin spoke at some length and with much enthusiasm. At the close of the dinner a considerable number of the party, including Mr Pupin, went to the State Museum to see the Flanagan model of Henry. A pledge was there given, by Mr Pupin, to those present, of a contribution of one-half the sum necessary to erect the statue, if that half did not exceed $15,000. There was no reporter present at either gathering, but the Albany *Times-Union*, of which Mr Glynn is editor and proprietor, said the next day (May 25th): "Professor Pupin, after seeing the statue and the instruments of the great inventor, exclaimed, 'There ought to be a monument erected to this great man. I feel so strongly about this matter that I tell you gentlemen now that I will pledge to raise $15,000 or one-half of the amount necessary, if you gentlemen will raise the rest.'" The Albany *Evening Journal* of the same date stated: "Mr Pupin said: 'If you people here will chip in and do your share, I will bring you $15,000 to help build this statue.'"

Mr Pupin's promise was received with enthusiasm by those gathered about the model and subscriptions were immediately made to the amount of $1000. A local committee was already in process of organization; the organization was at once completed, and the writer as its secretary-treasurer proceeded to raise the amount required to meet one-half the cost of the proposed statue. In the judgment of the committee, $25,000 was regarded adequate for this purpose and in due course the sum of $12,500 was subscribed and paid in (actually $12,700 now at interest in the Albany savings banks).

We went into the war. Mr Pupin, a Serbian by birth and at that time Serbian consul to the United States, was faced with imperious calls for help from that tortured country. Mr Pupin also became busily engaged in war service boards where his technical knowledge was required. These constituted valid reasons for deferring his part in the Henry statue agreement. In the spring of 1918, at the meeting of the National Academy of Sciences, he gave his word to the treasurer to pay his share "after the war."

III

THE SCIENTIFIC RESERVATIONS UNDER CONTROL OF THE MUSEUM

(WITH NOTES ON OTHERS)

The number of these reserves which have been set apart by the interest of private citizens and placed in control of the Museum, has been increased by the addition of *Squaw island*, Canandaigua lake, which has a special geological interest from the fact that the pebbles which compose it are algal balls or deposits of lime-carbonate produced by precipitation through the action of algal growth in the lime-bearing waters. The formation is highly instructive and the process by which these algal deposits or "water-biscuits" were formed was set forth some years ago by the writer in Museum Bulletin 39. Since then the island and its formation have become of increased interest, not alone from the fact that it is the only place known in the State where this process of algal action and lime-deposit is going on in this form, but also because these "water-biscuits" throw intimate light on the interpretation of the ancient algal reefs, such as the Cryptozoon reef near Saratoga and the great reefs in the Precambrian of the Rocky mountains. Squaw island is thus a geological monument worthy of protection and special note. Of late years the waters of the lake have been undermining the north end, but this encroachment it is now hoped may be stopped with the construction of a sea wall or a setting of willows. Through the interest of a benefactor of the Museum a large glacial boulder has been moved to the island from the grounds of Brigham Hall, three-fourths of a mile away, and to this has been attached a bronze explanatory tablet, these together constituting a conspicuous and appropriate interpretation to visitors, of the significance and educative interest of the place. The State Museum acknowledges its obligation in this matter to Mrs Frederick F. Thompson for the erection of the monument and tablet and for the protection of the shores of the island, and to Dr Robert C. Cook of Canandaigua for the gift of the boulder.

Stark's Knob volcano. This monument, situated 2 miles north of Schuylerville, has been provided with a proper series of guide and explanation tablets, and the electric railroad passing that point has established a station with landing and sign to be known as "Stark's Knob."

Cryptozoon ledge, near Saratoga; Clark reservation, near Jamesville. These two reservations have been carefully inspected. The

Edgewise conglomerate. Note groups of pebbles showing parallel arrangement including both horizontal and vertical. Best shown at base and at the right. The later growths of Stromatopora are well shown. Lockport dolomite, Sconondoa, Oneida co. N. Y.

Edgewise conglomerate. Lower part of view shows pebbles of Stromatopora which have been broken and slumped on sloping sea bottom. The pebbles are covered with the new growth of Stromatopora. From Lockport dolomite at Sconondoa, Oneida co. N. Y.

Edgewise conglomerate. Opposite view of specimen shown in preceding plate.

former is well monumented and is kept in order with comparatively little supervision. The latter, covering an area of 110 acres, some part of which is rough wild land, is under the inspection and patrol of a deputy sheriff, specially appointed, as the place is much visited because of its attractive geology, botany and scenery and as a result suffers considerable wear and tear which the present custody is unable to control. Reasonable expenditure is here required for fences, walks and stairways.

The "Devil's Pulpit." This is an extraordinary glacier-transported block situated about 2 miles east of Batavia on the property of Mrs Clark, along the highway to Le Roy. It has long been known and a picture of it was given in Hall's "Geology of the Fourth District" 1843. The old woodcut is here reproduced and, in com-

THE "DEVIL'S PULPIT" IN 1842
(From Hall's "Geology of His Fourth District," 1843)

parison with the photograph of the block as it now stands, shows that the lapse of nearly 80 years has made little difference in the appearance and form of the object. It is an interesting phenomenon. Its base 30 feet across is a mass of the unlaminated magnesian limestone known locally as "bull-head" and belonging to the strata immediately above the Lockport dolomite. Above this broad base is a narrowed mass of laminated hydraulic limestone which is capped by an expanded block of more compact material, the whole constituting a section of the Bertie waterlime, taking on a roughly hour-glass shape, having a height of about 20 feet. This Silurian

block rests on the Onondaga limestone (Devonian) plateau and has been transported by the glacier only a short distance, as the outcrop of these strata lies about 5 miles to the north. James Hall, in the report referred to, says: "There were formerly several of these on the road from Caledonia to Batavia but this is the only one now remaining." As the survivor of a number of these great transported blocks of especial interest because of the evidence they afford of the degree to which the outcropping edges of these Silurian strata were ripped up by the moving ice, the "Devil's Pulpit" bespeaks a watchful guardianship. The owners of the property on which it rests appreciate the interest attaching to it and during the past year, through the interest of Kirke B. Mathes of Batavia, the Holland Purchase Historical Society of that city has undertaken further responsibility for its protection, which is sufficient guaranty of its perpetuity. It is hoped that an explanatory tablet may be placed near the object.

Bird reservations. There has been evident a greatly increasing interest in the study and protection of birds throughout the State in the past few years, and this activity has been obviously fostered by the Museum publications on these themes. During the last year reports have been received of the organization of several new local clubs for bird study and of the establishment of bird sanctuaries on private grounds.

Chimney Island, St Lawrence river. Among others, the Ogdensburg Bird Club has been presented, by the generosity of John C. Howard, Esq. and Miss Mary Sherman of that city, with an islet in the St Lawrence river, called Oraconenton by the Indians, by the French, Isle Royale, and Chimney island in the present vernacular. It is now without human inhabitants but in the French wars played an effective part in the history of the St Lawrence valley. The Rev. D. Charles White of Ogdensburg has been kind enough to indicate the historical associations of the island which add much to its present interest. The French, under Levis, built a fort on the island and called it Fort Levis. This was in 1758 just before the fall of Quebec. Sir Jeffrey Amherst, who was wanted immediately after that event for the task of subduing Montreal, was taking his way thither in a leisurely and very indirect fashion from the south. By 1760 he was on detour to his destination and came by way of Isle Royale with a large force. The fort on the island, according to the account given by Knox, historian of the campaign, covered the entire surface of the island to its shores and was regarded as a strong redoubt, but

The "Devil's Pulpit" near Batavia. A transported block of hydraulic limestone. Courtesy of K. B. Mathes, 1919

it succumbed to Amherst's attack and Pouchot, its commandant, surrendered his force of 300 men. Lord Amherst then renamed the place Fort William Augustus. The island still holds traces of the French redoubt, and its historic association, together with its present purpose, serves to establish its interest to the community.

Little Duck Island, Maine. A few years ago Mr Benjamin Walworth Arnold of Albany, honorary curator of ornithology in this Museum, acquired possession of this island, which lies some 8 miles south of Mount Desert island, for the purpose of creating a protected lodge for the nesting water fowl. The fact of the existence of this bird sanctuary is too little known to American bird students and it is appropriate to the interests of this subject to present the following brief account of it which Mr Arnold has prepared:

Little Duck island lies some 8 miles south of Mount Desert island and is quite alone in the ocean. It has been the nesting home for sea birds away back into the dim past. There are no springs there, no fresh water, consequently many of the birds' vital enemies could not live there even if they succeeded in swimming from the nearest island across the four or five miles of open ocean intervening.

When the herring gulls leave the harbors of New England and farther south in the spring for their nesting places on the Maine coast, many come back to Little Duck island and by the middle of May the winter residents have moved northward and the summer residents have started to build their nests.

By counting the birds from different parts of the island as they return before sunset, we believe that from twelve to fifteen thousand gulls summer there, and this number is doubtless at least doubled by the young broods of three in each nest.

By about the first of June the eggs are all laid and by the first of July they are nearly all hatched and the young birds are running in the tall grass and weeds trying hard to hide from people as well as from some of the older gulls which occasionally become fierce and attack the young viciously, often killing a good many of them. The gulls' nests on Little Duck island are all on the rocks or on the ground. Many of them are under the smaller spruce trees but I believe they naturally prefer small depressions in the rocks.

Early in June the black guillemots (sea pigeons) lay their eggs in cavities in the rocks or under broken rocks. The guillemot's eggs are extremely beautiful and the two eggs lie in a slight depression in the rock or on a few small stones but always protected from rain by rock above.

Early in June the night herons return to the rookery on Little Duck. These very interesting birds, like the guillemots, are absolutely quiet at the nesting place and there is nothing to indicate the presence of the rookery until one is right upon the nests. The nests are built in thickets of small spruces and balsam, generally in easy reach from the ground.

Perhaps the most interesting member of Little Duck's summer colony is Leach's petrel, which arrives early in July, and in some years, is probably more numerous than all the other bird inhabitants combined. The petrels are weird little birds. They fly as if they constantly skimmed on the surface of the waves. The petrel has a little bump on the top of its bill similar to all the albatross family.

When handled, it secretes from its bill a yellowish substance of strong, rather objectionable odor. The petrel nest is at the end of a burrow perhaps two feet long and generally two to four inches under the surface of the ground but frequently under rocks. The petrel lays one white egg. Often this egg has very fine pinkish red spots at the larger end. The young petrel is a delightful little object, covered with down for the first month or so of its existence and almost as weird as its parents but not resembling them at all except in webbed feet and humped bill. Occasionally the petrels are so late in returning that some of the young are frozen before they are large enough to fly.

The petrel is perhaps the most interesting of the Little Duck bird colony. One of the birds remains in the burrow on the nest in the daytime and the other comes in at night to take its place. Some of the most interesting nights I have ever spent have been on Little Duck waiting for the petrels to come home. For an hour or more before sundown the gulls are returning to the island continuously and as each gull seems to have a great deal to say to his neighbors, the air is filled with a perfect bedlam of shouts and choruses which continue after the sun sets. As the darkness comes on the gulls become less and less noisy and gradually their stories seem to be told and they are quieter and quieter until only here and there some old gull continues to shout. Finally the last word has been said and Little Duck is absolutely still for perhaps a half hour until darkness has come and perhaps until you are beginning to think that there are no petrels coming in from the ocean. Very soon, however, you will see something fly swiftly past in the night and then you hear the peculiar twitter of the returning petrel as it flutters around you in search of its nest, and you will also hear the answer, an entirely different note, from the other petrel waiting at the mouth of the burrow for its mate. The flutter and twitter of the petrel continues through the night until an hour or so before sunrise, which we might call the hour of silence, is finally broken by the scream of a waking gull followed immediately by shrieks from thousands of throats and the day starts.

The birds on Little Duck island have a few enemies — an occasional snake destroys a petrel home and sometimes a crow is brave enough to taste a gull's egg, while the parent gull is absent, and in August and later there is often a duck hawk or an eagle or even a smaller hawk flying around the island looking for young gulls, but altogether the inhabitants of the island seem to be generally undisturbed and let us hope they are content with their existence.

Seneca Indian Monument at Canandaigua. Some years ago in making excavation necessary for the parking of grounds about the swimming school at the lake edge in the city of Canandaigua, a Seneca burial was uncovered which contained the skeletons of sixteen males lying in a half circle with feet toward the center and faces toward the lake. These remains were reinterred within the grounds and grove of the park and a rough stone monument placed above them. To this stone has now been attached a suitable bronze inscription tablet, suggested by this office and paid for by Mrs Frederick F. Thompson.

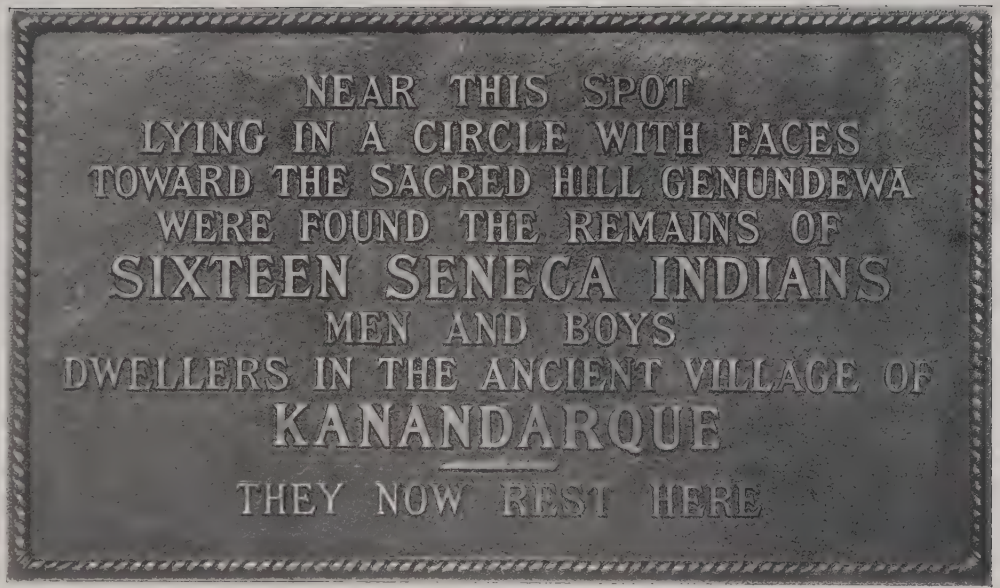
SQUAW ISLAND

NEW YORK
STATE MUSEUM RESERVATION

ACCORDING TO TRADITION IT WAS ON THIS ISLAND THAT THE WOMEN FROM THE SENECA VILLAGE AT KANANDARQUE, A MILE TO THE NORTHEAST, TOOK REFUGE AT THE TIME OF GENERAL SULLIVAN'S RAID 1779

SQUAW ISLAND IS OF UNUSUAL GEOLOGICAL INTEREST IT IS A SAND AND GRAVEL BAR MADE BY THE INFLOW OF SUCKER BROOK AND ITS BEACHES ARE COVERED WITH "WATER-BISCUITS" THE PEBBLES IN THE BEACH WATERS ARE COATED WITH A SOFT GREEN WATER-PLANT, OR ALGA LIKE OTHER PLANTS, THIS ALGA REQUIRES CARBONIC ACID GAS IN ORDER TO USE THE LIME IN SOLUTION THE BROOK WATERS CARRY THIS CARBONIC ACID GAS THE ALGA STEALS A PART OF IT AND IN CONSEQUENCE THE LIME IS DROPPED ON THE PEBBLE WHERE THE PLANT IS GROWING. BY THIS CONTINUOUS PROCESS THE "WATER BISCUITS" ARE BUILT UP THEY ARE COMPOSED OF A FELT OF PLANT THREADS COATED WITH LIME IN SUCCESSIVE LAYERS. ALGAE OR WATER-WEEDS OF THIS SIMPLE STRUCTURE WERE THE MOST ANCIENT LIVING THINGS OF THE WORLD THEY PRODUCED LIME DEPOSITS ON SO GREAT A SCALE AS TO MAKE REEFS IN THE SEA THE SQUAW ISLAND "WATER-BISCUITS" HAVE BEEN THE CHIEF MEANS OF INTERPRETING THESE ANCIENT SEA-PLANTS AND THEIR STONE REEFS.

DO NOT INJURE THE TREES AND BEACHES


NEAR THIS SPOT
LYING IN A CIRCLE WITH FACES
TOWARD THE SACRED HILL GENUNDEWA
WERE FOUND THE REMAINS OF
SIXTEEN SENECA INDIANS
MEN AND BOYS
DWELLERS IN THE ANCIENT VILLAGE OF
KANANDARQUE
THEY NOW REST HERE

IV

DEPARTMENT PUBLICATIONS

During the year the bulletins of the Museum have been issued as rapidly as circumstances permitted. They have the following numbers and titles:

200 Key to American Insect Galls. By E. P. Felt
201 Genesis of the Zinc Ores of the Edwards District, St Lawrence County. By C. H. Smyth, jr
202 33d Report of the State Entomologist, 1917. By E. P. Felt
203-4 High Grade Silica Materials for Glass, Refractories and Abrasives. By R. J. Colony
205-6 Report of the State Botanist for 1917. By H. D. House
207–8 Director's Report for 1917
209-10 Pleistocene Marine Submergence of the Hudson, Champlain & St Lawrence Valleys
211–12 Geology of the Lake Placid Quadrangle
213–14 Geology of the Schroon Lake Quadrangle

The State Museum Bulletin is now issued as a regular monthly periodical. This arrangement holds back in some degree the number of the reports which can be issued in any one year, as it seems impracticable with the present service to issue more than one a month, while it might be possible for the staff to prepare more than twelve a year.

V

REPORT ON THE GEOLOGICAL SURVEY

The progress of the areal geological survey of the State on the topographic scale of one mile to the inch has now progressed so far as to make it possible to reconstruct a geological map of the entire State on a smaller scale. There still remain considerable areas unsurveyed but for the most part these are bounded by other areas whose topography and geology are known, and on a lesser-scale map their surfaces might be covered with geological boundaries with approximate accuracy. There has been no geological map of the entire State issued since 1901, eighteen years ago. The progress of detailed field observation has made a new edition of the map on a scale of 5 miles to the inch almost imperative to meet the demands of commerce and of the schools. The creation of a new base map has been the chief obstacle to this procedure. The map of 1901 and the previous map of 1894 had a very imperfect base due to the fact that but little of the topographic survey had been done. The provision recently made by the Legislature for the production of a base map of the State on the scale of 4 miles to the inch which can be used for various departmental purposes would have helped forward this plan although the scale is larger than that we have hitherto used but not too large for the great amount of detail which a geological map must now of necessity carry. Unfortunately the provision thus made failed to meet the approval of the Governor.

Lyon Mountain Quadrangle. Dr William J. Miller reports his operations in this region as follows:

With the exception of the glacial and postglacial deposits, all the rocks of the quadrangle are of Precambrian age. Oldest of all are a few small remnants of the Grenville series badly cut to pieces and more or less assimilated and highly injected by the intrusive rocks.

So far as known, the next oldest rocks are gabbro and hornblende gneiss or amphibolite. Much of the gabbro, which usually has an ophitic texture and is very massive, is clearly older than the granites of the region, and younger than the Grenville, as shown by the field relations. Some of the gabbro, as is well known for the Adirondacks in general, may be younger than the syenite-granite series, but no positive proof for such younger gabbro was obtained. In many places the true gabbro grades into hornblende gneiss or amphibolite. But it is by no means certain that all the hornblende gneiss

and amphibolite of the district are facies of the old gabbro. Some may be younger, and some may possibly represent metamorphosed portions of the Grenville series.

Anorthosite, which is clearly younger than the Grenville, and older than the syenite-granite series, occurs in several small areas. It is mostly of the Whiteface type. Its age relation to the old gabbro could not be definitely determined.

Several varieties of granite, granitic syenite and quartz syenite constitute the main bulk of the rocks of the quadrangle. Among these the variety of chief interest is a fine to medium-grained, usually pink, rock locally varying from a true granite through granitic syenite to quartz syenite or even quartz diorite. A magmatic flow-structure foliation is generally more or less well developed. The writer has called this rock the "Lyon Mountain granite" because of its excellent exposures in and near Lyon Mountain village. The rock is also extensively developed in Johnson mountain, Duncan mountain, and in the valley of the Saranac river.

There is considerable evidence to show that the Lyon Mountain granite grades into, and is only a facies of, a coarse-grained, usually gneissoid rock which the writer has called the "Hawkeye granite" because of its excellent exposures in the vicinity of Hawkeye village. This rock is extensively developed in Silver Lake mountain, in the southwestern portion of the quadrangle, and in the southeastern half of the great mass of Lyon mountain.

Special mention should be made of the dikes and other masses of pegmatite and silexite, and dikes of aplite, which, in age and origin, are closely associated with the granites. The Lyon Mountain granite contains a great profusion of pegmatite and silexite [1] masses and no aplite dikes, while the Hawkeye granite contains many aplite dikes and relatively few pegmatite and silexite masses. The relations of the pegmatite and silexite masses to the inclosing granite make it clear that they both began to develop, probably as segregation masses, while the granite magma still possessed a considerable degree of fluidity, and that they continued to form, probably both as segregation products and as dikes, until the inclosing granite almost or possibly completely solidified. The silexite masses represent very siliceous facies of the pegmatitic development, gradations from nearly pure silica to ordinary pegmatite being not uncommon.

[1] The term "silexite" has recently been proposed by the writer (Science, 49: 149) for any body of pure or nearly pure silica of igneous or aqueo-igneous origin which occurs as a dike, segregation mass, or inclusion within or without its parent body.

Most of the pegmatite, silexite and aplite by far occur within the parent granites, though some also occur in the remnants of the old rocks which were intruded by the granites.

In many places the older rocks, including the Grenville series, gabbro and hornblende gneisses (or amphibolites), have been more or less injected or assimilated by the Lyon Mountain granite and its pegmatitic facies, giving rise to a great variety of mixed rocks. Injection and assimilation of the old gabbro and hornblende gneisses are of particular interest because, as a result of these processes, the hornblende and hypersthene have usually been largely or wholly transformed into green monoclinic (apparently mostly diallage or diopsideaugite) relatively free from iron with accompanying separation or magnetite. Also in many places the Lyon Mountain granite (or its pegmatite) is locally notably more basic than normal and it then contains considerable green monoclinic pyroxene and magnetite, this change in composition having resulted from more or less perfect assimilation of portions of gabbro or hornblende gneiss by the granite magma.

The magnetitic iron ore deposits of the quadrangle are of particular interest, especially those in and near Lyon Mountain village where mining operations are now being carried on by the Chateaugay Ore and Iron Company. Many years ago iron ore was taken from about a dozen other localities, mostly in the Saranac valley. Because of the development of magnetite as a result of the transformation of hornblende and hypersthene into monoclinic pyroxene, the injection or assimilation rocks are commonly distinctly richer in magnetite than either the normal Lyon Mountain granite or normal gabbro or hornblende gneiss. But much of the derived magnetite was carried away in magmatic solution and deposited elsewhere, in many cases to form the ore zones. These iron ores are not, therefore, magmatic differentiation deposits in the true sense of the word.

With the possible exception of some gabbros later than the granites, the only other rocks (not including the Pleistocene) of the Lyon Mountain quadrangle are small dikes, mostly diabase, which have been found in more than 120 localities. These dikes always have sharp contacts, and they are the latest of the Precambrian rocks of the region.

Late Cambrian, and possibly also Ordovician, strata formerly must have extended well into the quadrangle because the Potsdam sandstone now lies close to its borders on the east and northeast, and the Ordovician is not many miles away to the east.

Comparatively little positive evidence for faulting was observed.

Glacial striae show that the general direction of ice movement during the Ice age was southwestward across the quadrangle. During the withdrawal of the ice the area was widely strewn with ground morainic materials containing many boulders. Much fluvioglacial material was also deposited, especially on the lower lands. A very conspicuous kame-moraine 12 miles long, extending from southwest of Goldsmith to near Hammond school, was formed along the margin of an ice-lobe which paused temporarily during its retreat from the Saranac valley. Smaller kames, and at least one esker, were also observed. Glacial lake waters formed at various levels during the retreat of the ice, especially in the Saranac valley, as shown by well-preserved delta sand plains. The gorge and waterfalls south of Moffitsville are of postglacial origin, the old channel of the river having been a little farther west.

INDUSTRIAL GEOLOGY

BY DAVID H. NEWLAND

Report on mineral resources. The need for a revision of previous information about the mining and quarry resources of the State has been emphasized during the last year or two by the many changes and developments that have taken place in the several related industries. It has been a time of unprecedented activity and the possible scope of productive operations has been enlarged through the growth of market demands for some of the staple commodities and the coming into use of certain materials that hitherto were regarded as of little account. Though the gains thus recorded may not prove permanent additions to the industrial field, the effects of the increased activity and developments will provide a stimulus which can hardly be otherwise than beneficial.

The new report is designed to serve as a general guide to the subject, indicating what kinds of ores and minerals occur in sufficient quantities to be of commercial interest and giving particulars of their distribution and such features of their geology as have a practical bearing upon their utilization. The treatment is comprehensive, but not exhaustive. In accordance with plans already in force, separate monographic reports will continue to be provided for the more important branches of the mining and quarry industry, such as have been issued in recent years upon iron ores, pyrite, zinc, building stones and other subjects of current interest.

It is not out of place perhaps to call attention here to the revival of gold-mining ventures, which it was thought had run their course and ceased to be of general interest after the record of universal failure that attended such enterprises in former years. Many wrecks of mine and milling plants for the extraction of gold, on which hundreds of thousands of dollars were expended, are scattered over the Adirondacks. So far as can be learned from diligent inquiry, supplemented by the results of actual tests upon the materials exploited, there has never been any recovery of gold whatsoever by these plants. Yet the claims have been published that the Adirondack sands will yield $4 or $5 and even up to $50 in gold when treated by some special process. The process, in fact, which is usually surrounded by more or less secrecy and mystery, seems to be the main element of consideration in the capitalization of such enterprises; the deposits upon which the process is employed are simply the ordinary glacial sands that cover most of the Adirondack valleys and that represent the detritus of the crystalline rocks of that region — granite, gneiss, gabbro, anorthosite etc. Careful assays, using large samples of the sands for the purpose, fail to disclose anything more than the merest trace of gold or silver. The only new feature that has been introduced in the later promotions is the intimation that platinum accompanies the other precious metals. However opportune the suggestion may be in view of the enormous accretion in value of platinum in the last two or three years, it hardly changes the situation with regard to the value of the deposits. The attempts to awaken public interest in these ill-founded ventures are deprecated as working an injury upon legitimate enterprise, and it will be the aim of this office, as in the past, to discourage their inception as a matter of policy.

Silica for glass and refractories. The inquiries received by the office in regard to the possibility of securing supplies of high-grade silica rock from local deposits suggested an investigation of these resources. The demand for silica materials has been largely augmented through its employment in the manufacture of such products as ferro-silicon, optical glass and refractory linings for metallurgical furnaces. The investigation was undertaken by R. J. Colony of Columbia University, who devoted a part of the summer to the necessary field work and supplemented this with laboratory studies in New York. The materials investigated for the purpose were the Poughquag quartzite of Dutchess and Westchester counties, the Shawangunk conglomerate that forms the crest of that mountain

in Ulster, Orange and Sullivan counties, the Oriskany sandstone at Oriskany Falls, the Potsdam sandstone on the northern, eastern and southern borders of the Adirondacks and the quartz sands of the Oneida lake region. It was found that the Oriskany and Potsdam sandstones afford the most suitable material for making the better grades of glass; the Potsdam of the northern Adirondack area representing the best to be found in that formation and of about the same grade as the Oriskany sandstone. Both sandstones show phases which possess a loose granular habit so as to crush down to sand which then can be washed. A washed sample of the Oriskany showed on analysis 99.82 per cent silica and .06 ferric oxide. A sample of Potsdam from the Moira-Bangor area of Franklin county returned 99.54 per cent silica and .01 ferric oxide. All the silica rocks investigated were adapted to ferro-silicon manufacture, containing materials well within the silica requirements for that use.

For refractory linings and for use in tube mills the Poughquag quartzite and the Shawangunk grit appear most adaptable, as they possess the required qualities of physical structure in addition to chemical composition. It is believed the report will meet the needs which have been expressed frequently by consumers of these materials.

Salt investigation. A study of the salt deposits and industry is in progress and will be completed probably during the coming year. The work was inaugurated for the purpose of securing definite information about the potash content of the rock salt and to inquire in the possibilities of utilizing the waste liquors of the evaporating plants for extraction of the potash. The chemical examination of many samples from different localities in the salt district has shown that there is only a very small proportion of the substance in the salt and its extraction would not be likely to prove commercially feasible. However, it has been deemed advisable to make a comprehensive report on salt resources of the State, since there has been little published in regard to them since the appearance of the bulletin "Salt and Gypsum Industries in New York" in 1893. Mr Harold L. Alling is cooperating with the office in the preparation of the report. Mr Alling has also given some further attention to the examination of graphite properties and products in continuation of work upon which a report was rendered the year before.

Mineral production. A statistical canvass of the mineral industries for the year 1917 was conducted by the office in cooperation with the United States Geological Survey in continuation of the work

that has been carried on for a number of years and summarized in a series of annual bulletins. Owing to the press of other duties, as well as the difficulties in securing prompt publication, the summary was not available as early as heretofore. The principal features of the year's record only will be referred to here. It was a period of extraordinary conditions, marked by unprecedented activity in certain departments of industry and by violent reactions and curtailment of output in others. The aggregate value of the mineral production upon the basis of the crude or first marketable forms of the materials, amounted to $51,943,796, a gain of $5,995,849 over the total for the preceding year, and the largest value returned up to the present time. Not all the increase may be attributed to actual increments in the quantities of the materials produced; since prices for the more essential commodities also advanced. The production of iron ore was 1,356,011 long tons, valued at $7,381,333; that of zinc ore 47,961 tons, valued at $1,059,186; and that of pyrite 57,075 tons valued at $354,000. These represented the more important metallic minerals. Among the nonmetallic products were: salt, 15,457,636 barrels ($5,371,713); portland cement, 5,408,726 barrels ($7,050,656); gypsum, 606,268 tons ($2,036,820); petroleum, 879,685 barrels ($2,850,378); natural gas, 8,371,747,000 cubic feet ($2,499,303); talc, 74,671 ($881,462); building brick, 660,183,000 ($5,118,966); pottery, valued at $4,076,817; other clay products, valued at $2,232,616; quarry products, valued at $6,283,556; molding sand, valued at $808,550; other kinds of sand, valued at $2,237,897; and many minor products including apatite, natural cement, crude clays, diatomaceous earth, emery, feldspar, garnet, marl, millstones, metallic paints, mineral waters, quartz, sand-lime brick, slate, representing altogether a value of $1,430,293.

PALEONTOLOGY

In the expansion of the monographic treatment of the early geological formations and their fossil contents, work has been completed on the faunas of the Utica, Frankfort and Lorraine formations.

The life zones that have been distinguished (three in the Utica and eight in the Lorraine) were mentioned in the last report. The closer study of the faunas has shown that our development of the Cincinnatian division contains about 250 species, one-third of which are forms known before from New York, another third known before from Ohio, Canada etc. and the remainder are new to science. Comparison of the different life zones with those of the adjoining

erritories has shown that the Utica zones have, especially in their raptolite contents, a distinctly Atlantic aspect and that the faunas robably reached this State from the southeast; the fauna of the lack shale of the Black River valley, however, came from the t Lawrence region and represents a different invasion. The rankfort faunule is only a depauperate Utica fauna, but of younger Economy and probably also early Southgate) age. The lower orraine shale is equivalent to the Eden of Ohio and here termed ie Whetstone Gulf formation on account of distinct local develop- ient of certain species. This shale was evidently deposited in the den sea which, invading from the southwest, reached the Adirondack assive. The upper Lorraine or Pulaski fauna, on the other hand, hows a close relationship to the contemporary faunas of the Quebec egion and points to an open marine connection to the northeast n later Lorraine time, together with a wide expanse of sea toward ie west. Charts of the different stages have been prepared; they ill show the extent of the successive invasions and the differences n contemporaneous sedimentation.

The Monograph of the Devonian Crinoids of New York is com- leted. It includes 60 genera, 144 species and 8 varieties, of which 7 genera, 54 species and 6 varieties are new. A number of new ombinations of species have likewise been made. Six of the species ncluded have been found only outside the State, some of them ntroduced for comparison; eighteen species and one variety occurring n New York State have also been found in the Devonian elsewhere.

The species described include many interesting forms, particularly om the Upper Devonian. Ontogenetic studies have been made herever possible, though material has not been sufficiently abundant o allow this to be carried to any great extent. Such observations, nd observations on variation within the species, have been noted nder the heading "*Ontogeny*" or "*Ornamentation*" in the description f the species. A very complete ontogenetic series of Melo- crinus paucidactylus is described and figured. The ost striking difference shown here between young and adult forms in the character of the arms which are simple and two to a ay in the youngest forms; compound with armlets in the older orms.

In the study of the young it has been found that, outside of changes n ornamentation, there are two particular regards in which immature nd mature forms differ: the extent of incorporation of the brachials nd the character of the arms. These observations have been

made on a number of species, such as Megistocrinus depressus, Megistocrinus ontario, Aorocrinus cauliculus, etc., in which young forms have been found. Variation within the species is common and is particularly well shown in Megistocrinus depressus.

A very interesting and fairly complete series of Dolatocrinus liratus shows particularly well the changes in ornamentation of the dorsal cup which accompany the growth of the individual. The young specimens show a deeply excavated basal region and fewer, coarser ridges or carinae. With growth the basal pit gradually becomes filled up and the carinae become more numerous and finer. The ornamentation finally becomes very complex, as seen in the "Multilira" type, and in older forms the carinae break up forming scattered tubercles. Study of other species, such as Rhodocrinus nodulosus, Dolatocrinus glyptus, Gennaeocrinus eucharis, Gennaeocrinus nyssa, Gennaeocrinus carinatus, Decadocrinus multinodosus, seems to indicate a general tendency for the ornamentation to reach its greatest development in mature individuals and to break up or become less pronounced in old ones.

REPORT OF THE MINERALOGIST

Chemical and mineralogical investigations. The chemical laboratory was cleaned, refitted, new apparatus bought and over $500 worth of platinum ware loaned to us. Most of the year has been spent on chemical analyses and investigation. A summary of this work follows:

		Number of quantitative determinations
1	Graphite analyses for Mr Alling's graphite report	63
2	Analyses for new salt bulletin:	
	1 Boiler scale analysis	6
	2 Grainer scale analyses	6
	4 Rock salt analyses	18
	2 Evaporated salt analyses	11
	7 Bittern analyses	49
	1 Brine analysis	7
	1 Table salt analysis	7
	Brine research analysis	21

3 In the writing of a report on the discoloration of the pillars of the Education Building, 73 quantitative determinations were made, 54 of which were published in the report. The interesting fact was discovered that the yellow stain is due to sulphuric acid in the air causing the formation of gypsum stained with iron oxide on the marble.

Analyses, pillar scale, marble and granite	73

4 In writing with Prof. A. J. Moses an article on two definite varieties of the rare mineral tungstite and investigating the condition of the water therein, the following quantitative determinations were made:

Water	225
WO_3	12
Specific gravity	6

5 The following miscellaneous analyses were made at the request of the State Geologist or the Assistant State Geologist:

1 Fullers earth	6
1 Arsenopyrite	12
1 Magnetite	6
1 Pyrrotite	1
1 Pyrite	6
5 Shales	27
2 Graphites	14
1 Assay platinum	1
1 Assay gold	1
1 Water	5
1 Peat	1

6 On the various minerals and specimens brought in or mailed in by members of the staff or people of the State, the following work was done:

Quantitative determinations	7
Qualitative determinations	52
Minerals determined by sight	93

Total quantitative determinations	581
Total qualitative determinations	52
Total sight determinations	93
Total	**726**

VI

REPORT OF THE STATE BOTANIST

Scientific investigations. The investigations of the State Botanist during 1918 have been largely directed toward the completion of a catalog of the flora of the State.

Among the early catalogs of the State flora, perhaps the first is that by Jacob Green, published at Albany in the Transactions of the Society for the Promotion of Useful Arts, volume 5, 1814. It was followed in 1837 by Torrey's Catalogue of the Plants of the State, revised in 1840. Torrey's work culminated in the publication in 1843 of the well-known *Flora of New York* (Natural History of New York) in two volumes, and it was supplemented by a revised catalog in 1849 and 1866. Since then our knowledge of the flora of the State has developed greatly and rapidly, but the results of this advance are, for the most part, scattered through the pages of many different publications. The annual reports of the State Botanist from 1869 to date have been the repository of much of the information regarding new additions and new knowledge of the vegetation of the State. Numerous botanical periodicals which have come into existence during the past thirty-five or forty years also contain a large amount of scattered information relative to our flora.

Space does not permit the enumeration of the many local floras. A complete bibliography of the botany of the State published in Museum Bulletin 188 covers this phase.

These sources of information, together with the several large herbaria which contain extensive collections of the plants of the State, serve as the foundation of this catalog which will appear as a separate publication.

Identifications. The number of specimens identified by this office during the year is 380, and the number of persons for whom these identifications were made is 102. This includes identification of poisonous and edible mushrooms, diseased plant material, woods, seeds, ferns and flowering plants.

Additions to the herbarium. The number of specimens of New York State species which have been added to the herbarium from current collections during the year is 360; from the contributions 462, a total of 822 specimens. Of these a large number are new to the herbarium.

Collections were made by the State Botanist in the following counties: Albany, Genesee, Herkimer, Madison, Monroe, Oneida,

Onondaga, Ontario, Oswego and Rensselaer. These collections were made largely in connection with a continuation of a study of the bog vegetation of southern Herkimer and Madison counties and also Bergen swamp in Genesee county.

The mycological herbarium. During the past five years considerable time has been devoted to the rearrangement of the extensive collection of fungi accumulated almost exclusively through the efforts of the late Dr Charles Horton Peck.

An enumeration of the number of specimens representing each group of fungi is interesting and of some value as a record of his work, and also constitutes a record of the present number of specimens of fungi in the state herbarium.

AGARICACEAE

Agaricus	250	Leptonia	85
Amanita	300	Naucoria	195
Armillaria	65	Nyctalis	3
Bolbitius	12	Omphalia	230
Cantharellus	252	Panaeolus	125
Amanitopsis	130	Panus	115
Annularia	2	Paxillus	80
Clitocybe	650	Marasmius	515
Collybia	262	Nolanea	55
Coprinus	530	Pholiota	380
Cortinarius	575	Montagnites	2
Claudopus	51	Pilosace	4
Crepidotus	170	Pleurotus	228
Deconica	40	Picatura	3
Entoloma	220	Trogia	21
Flammula	215	Pluteus	110
Eccilia	35	Psathyra	28
Galera	180	Psathyrella	47
Gomphidius	60	Psilocybe	142
Hebeloma	98	Pluteolus	35
Hygrophorus	477	Russula	875
Hypholoma	205	Stropharia	64
Inocybe	75	Schizophyllum	15
Laccaria	73	Tricholoma	535
Lactarius	651		
Lentinus	125		
Lepiota	352		
Mycena	281	Total	10 328

POLYPORACEAE	2 375
BOLETACEAE	1 020
HYDNACEAE	1 025
THELEPHORACEAE	375
CLAVARIACEAE	760
GASTEROMYCETEAE	345
MYXOMYCETEAE	960
PHYCOMYCETEAE	75
PEZIZEAE	1 225
HELVELACEAE	315
UREDINALES	3 410
PYRENOMYCETEAE	1 725
MELANCONEAE	75
HYPOMYCETEAE	355
Host herbarium (specimens of various families arranged according to host)	8 350
Undistributed material (estimated)	900
Total number of specimens of fungi	33 618

Specimens contributed to the state herbarium. During the past year the following contributions of specimens have been received and added to the state herbarium:

George S. Graves, Newport	310
M. S. Baxter, Rochester	45
H. C. Beardslee, Asheville, N. C	35
L. S. Slater, Cairo	25
Dr A. H. W. Povah, Syracuse	14
Dr J. J. Davis, Madison, Wis	12
Mrs E. P. Gardner, Canandaigua	8
Herbarium Prince Bonaparte, Paris	6
S. H. Burnham, Hudson Falls	2
Miss Florence Beckwith, Rochester	1
Dr H. M. Fitzpatrick, Ithaca	1
W. C. McCalla, Edmonton, Canada	1
Dr L. H. Pennington, Syracuse	1
Dr W. G. Farlow, Cambridge, Mass	1
Total	462

PLANTS ADDED TO THE HERBARIUM

New to the herbarium

Ascochyta silenes *E. & E.*
Calopactis singularis *Sydow*
Cercospora p ntstemonis *E. & K.*
Cercospora streptopi *D. & B.*
Corticium corruga *Burt*
Corticium lividum
Cortinarius iodioides *Kauff.*
Aphemerum cohaerens (*Hedw.*) *Hampe*
Gymnosporangium betheli *Kern*
Gymnosporangium nelsoni *Arth*
Hydnum subsquammosum *Batsch*
Hydnum putidum *Atk.*
Inocybe corydalina *Quel.*
Marssonina toxicodendri (*E. & M.*) *Magn.*
Melampsora arctica *Rostr.*
Naucoria christinae *Fr.*
Peridermium fischeri *Kleb.*
Poria tsugina *Murrill*
Puccinia commutata *Sydow*
Puccinia cinerea *Arth.*
Puccinia ellisii *DeToni*
Puccinia holboellii *Rostr.*
Puccinia tuberculariS *E. & E.*
Puccinia universalis *Arth.*
Psilocybe ammophilus *D. & M.*
Radulum casearium (*Morg.*) *Lloyd*
Rhomes putearius *Weir*
Sperlesiella nigerrima (*Bloxham*) *Sacc.*
Russula aurantialutea *Beardslee*
Russula cinerascens *Beardslee*
Russula magna *Beardslee*
Russula tenuiceps *Kauff.*
Russula melioleus *Gmel.*
Russula pungens *Beardslee*
Uredinopsis pteridis *D. & H.*
Uromyces hedysari-obscuri (*DC.*) *Wint.*
Uromyces heterodermus *Sydow*
Uromyces rosicola *E. & E.*
Uromyces spartiniae *Farlow*
Woehmeria drummondiana *Weddell*
Lycopus asper *Greene*
Panicum flexile (*Gattinger*) *Scribn.*

Reprint of the Report of the State Botanist for 1886; from the Fortieth Annual Report of the State Museum 1887

Through an oversight on the part of the state printers (Weed and Parsons) no edition of the fortieth annual report of the Museum was printed except those necessary for the legislative documents. This report has consequently never been distributed and as it contained many original descriptions of plants by the State Botanist, Dr Charles H. Peck, it is an important work of reference, especially for students of mycology. To supply a constant demand which it has hitherto been impossible to meet the Botanist's report is here reprinted without change and page for page.

REPORT

To the Honorable the Board of Regents of The University of the State of New York:

GENTLEMEN:— I have the honor to communicate to you the following report:

In prosecuting the work of completing and arranging the State herbarium the past year, specimens of plants of the State have been collected in the counties of Albany, Genesee, Essex, Hamilton, Livingston, Montgomery, Rensselaer, Saratoga, Schoharie, Washington, Wayne and Wyoming.

Specimens of 184 species have been added to the herbarium, of which twelve were contributed by correspondents, and 172 were collected by the Botanist. Of these 106 are new to the herbarium, and with two exceptions are new to our flora. Forty-seven of them are regarded as previously unpublished species. Among the added species are seven flowering plants, one moss and one lichen. The remainder are fungi. A list of the additions accompanies this report and is marked "A."

The number of contributors is twenty-three. Among their contributions are specimens of many extra limital species, not included in the preceding enumeration. These are kept distinct from the herbarium proper, which represents the State flora. A list of the contributors and of their respective contributions is marked "B."

A paper containing notices of species not before reported, together with a record of their respective localities and descriptions of new species, is marked "C."

Notes and observations concerning those not new to our flora will be found in a paper marked "D."

Wishing to obtain good flowering specimens of certain plants which grow upon the summit of Mt Marcy, that locality was visited early in June. Although the snow had not yet entirely disappeared from that high elevation, several of the desired plants were in full bloom. Fine specimens were obtained of the alpine

rosebay, *Rhododendron Lapponicum*, the Lapland diapensia, *Diapensia Lapponica*, the hairy fly honeysuckle, *Lonicera cærulea*, and the dwarf birch, *Betula glandulosa*. The hairy fly honeysuckle and the small cranberry had not before been observed by me on the open summit of the mountain and should be added to the list of plants already published as belonging to that elevated station. July is given in the Manual and also in the State Flora as the time of flowering of the alpine or Lapland rosebay, but here it was flowering finely on the tenth day of June. Several new and interesting species of fungi rewarded my search in that bleak locality. Near the base of the mountain, the few fruited June berry, *Amelanchier Canadensis*, var. *oligocarpa*, enlivened the dark evergreen forest with its few pure white flowers. These are much scattered on the branches, there being only one, two or three in a place. The petals are broadly oval or almost orbicular, and the branches are wide-spreading, straggling and irregular. These features are so unlike the corresponding ones in other varieties of the species, that for the instant they almost compel us to believe that the plant is a distinct species rather than a mere variety. Yet, in less elevated and more open places connecting forms appear. Along Marcy brook, the rare mountain bush cranberry or few flowered viburnum, *Viburnum pauciflorum*, was observed, but it was not yet in flower. At Ausable ponds the large leaved avens, *Geum macrophyllum*, was discovered. This is a notable addition to our flora. It is an inhabitant of the White mountain region of New Hampshire and of the Lake Superior region, whence it extends westward to the Sierra Nevada mountains, and northward to Sitka. This New York station is intermediate between the eastern one and the nearest western one. An interesting form of the northern Clintonia was also discovered at this time. In it, one or two lateral umbels project from the scape at short distances below the terminal umbel of flowers. I find no mention of this form in our botanies. It is apparently due to a very thrifty and vigorous condition of the plant. The number of flowers in an umbel often much exceeds the number ascribed in the descriptions of the botanies.

From time to time reports have reached me that a red-flowered form of the white water-lily, *Nymphaea odorata*, existed in some of the waters of the Adirondack region. As I had never been

ble to find such a plant myself, these reports were somewhat tantalizing. Knowing that such a lily had been found in Massachusetts, and learning of a definite locality where it was reported to have been seen in the Adirondacks, I determined to test the accuracy of this report, and to add, if possible, a specimen of such a rarity to the herbarium. Mud pond, in which it was said to grow, is a small, boggy water-hole, between Long lake and Tupper's lake. Upon visiting it I found an abundance of the white water-lily. There were a few flowers scattered about, in which the external petals were considerably tinged with red. When these flowers were but partly open, and viewed at a short distance, they had a decided pink-red appearance, and might easily be mistaken for the variety in question. But a closer examination invariably revealed white interior petals, though in some instances these were slightly stained with red or pink on the exterior surface near the base. Thus far the occurrence of the real red water-lily in the Adirondack region has not been verified by me; but this half-way approach to it indicates the possibility of its existence there, and raises the hope that it may yet be added to our flora. In this bog hole the bayonet rush, *Juncus militaris*, was found growing plentifully. It is an interesting addition to the indigenous plants of the State. On this trip, groves of larches or tamaracks, *Larix Americana*, in three widely separated localities, were noticed, in which many of the trees were almost defoliated by the ravages of some insect. Among them were many trees already dead, evidently having yielded to the thorough manner in which they had been deprived of their foliage. It appears that the loss of a large percentage of the larch trees of these noble forests must yet be added to the loss of many of the spruces through the agency of pestilent insects.

Wishing to observe what influence had been exerted on the flora by the operation of the salt works at Warsaw and its neighboring localities, that place was visited. It is well known that certain so-called seaside and salt marsh plants occur at Onondaga lake, about the salt works at Salina, and in other places where there are saline influences. It is evident that at Warsaw no saline influences have been present until quite recently. No salt springs come to the surface. The salt water is manufactured, so to speak, and pumped up from great depths. No salt marsh plants existed there when

the salt wells were first opened. Had any been introduced and established there since that time, was a question, the answer to which I wished to put on record. Not a single plant of this character was found. The nearest approach to it is the common orache, *Atriplex patula*, which grows freely along the sea coast; but this plant is also capable of living and thriving in places remote from salt water or saline influences. It has followed the tracks of our railroads till now it is a common plant along these thoroughfares in many places in the interior of the State. At Warsaw it is abundant, and occurs in several well-marked forms, thus showing well its dipsosition to vary. Its fondness for salt water, however, is shown by the fact that it is especially vigorous along the ditches by which the waste brine is carried away, and it follows these for considerable distances. Some of the trees in the immediate vicinity of several factories were seen to be dead or dying. Their death was apparently due to the gaseous products of the combustion of coal which is used in running the works. They were not in reach of the brine.

Two opinions are entertained concerning the liability of plants to the attacks of parasitic fungi. Some claim that, no matter how vigorous and healthy a plant may be, if the spores of its parasite lodge upon it the result will be the development in it of the disease which that parasite generates in that particular host plant. Others claim that there is a difference in the susceptibility of plants of the same species to the attacks of the same parasite; that a plant in a weak, starved or feeble condition is more likely to yield to and suffer from the attacks of its parasites than is one of the same species which is strong, well fed and vigorous. In other words, it is claimed that the vigorous plants, though exposed to the action of the spores of the parasite, have the power to resist the development of the disease and to remain healthy and unaffected; while the more feeble ones, exposed to the action of the spores of the same parasite, yield to the disease and suffer therefrom. This last claim is one of great practical importance, and if it can be shown to be well founded, a knowledge of it may be useful. Two instances illustrative of it fell under my observation the past season.

At Warsaw a small patch of knotgrass, *Polygonum aviculare*, was noticed. The plants were very small and starved in appear-

ance, and seemed to be struggling for existence. A close inspection showed that many of them were affected by a parasitic fungus, *Uromyces Polygoni*. On one side of this patch, and continuous with it, was one composed of taller, more healthy looking plants. These were entirely free from the fungus, thus indicating that the weakness of the plants in one patch had favored the development of the disease, while the strength of the plants in the other had resisted it. It might be said by the supporters of the other claim that the dwarfed and weak condition of the affected plants was due to the presence of the fungus and not the predisposing cause of its presence. To one accustomed to observe this fungus, such an assertion would carry but little weight. But if we should admit the truth of this assertion, how should we explain the presence of the dwarf but unattacked plants in this patch?

In low ground near the lake shore at Port Henry, were numerous seedling plants, apparently of the discoid tickseed, *Coreopsis discoidea*. This ground had been overflowed in time of high water, and when the water receded it left numerous heaps of small sticks, bits of bark and other floodwood. Many of the seedling tickseeds were growing on these heaps of rubbish where there was little or no soil to afford nutriment to their roots. Others were growing on the ground about them, having their roots imbedded in and nourished by the soil. The plants growing on the floodwood were in many instances infested by a parasitic fungus, *Peronospora Halstedii*; but not a single affected plant could be found among those whose roots were in the soil. In this case the better nourished plants had escaped infection, although as much exposed to it as their less favored companions. Possibly there may be cases in which plants are liable to the attacks of parasitic fungi, no matter how strong and vigorous they may be, but it is clear that this can not be a rule without exceptions. Instances are not wanting to show a greater susceptibility to attack in weak than in strong and well fed plants. Those who are accustomed to collect specimens of parasitic fungi soon learn, almost unconsciously, to look for them, either among feeble and starved plants or among those of unusually rank and luxuriant growth.

Very respectfully submitted

CHAS. H. PECK

ALBANY, *December* 15, 1886

(A.)

PLANTS ADDED TO THE HERBARIUM

New to the Herbarium

Geum macrophyllum *Willd.*
Aster sagittifolius *Willd.*
Lactuca Scariola *L.*
Mimulus moschatus *Dougl.*
Amianthium muscaetoxicum *Gr.*
Juncus militaris *Bigel.*
Alopecurus pratensis *L.*
Distichium capillaceum *B. & S.*
Calicium eusporum *Nyl.*
Collybia fuliginella *Pk.*
Clitopilus subvilis *Pk.*
Hebeloma glutinosum *Lind.*
Polyporus dryophilus *Berk.*
P. sinuosus *Fr.*
P. radiculosus *Pk.*
Hydnum velatum *B. & C.*
H. subfuscum *Pk.*
H. carbonarium *Pk.*
Irpex ambiguus *Pk.*
Porothelium papillatum *Pk.*
Thelephora dendritica *Berk.*
Stereum abietinum *Pers.*
Hymenochaete tenuis *Pk.*
Clavaria Kromholzii *Fr.*
Phyllosticta Caryae *Pk.*
P. phaseolina *Sacc.*
P. Lycopersici *Pk.*
P. phomiformis *Sacc.*
P. tumoricola *Pk.*
P. populina *Sacc.*
P. spermoides *Pk.*
P. faginea *Pk.*
P. vagans *Pk.*
P. fatiscens *Pk.*
P. Symphoricarpi *West.*
Phoma magnifructa *Pk.*
P. leguminum *West.*
P. eupyrena *Sacc.*
P. Populi *Pk.*
P. herbarum *West.*
P. Castanea *Pk.*
P. Dipsaci *Sacc.*
Aposphaeria conica *Sacc.*
Cytospora grandis *Pk.*
Haplosporella Pini *Pk.*
Diplodia paupercula *B. & C.*
D. Asparagi *Pk.*
Stagonospora Chenopodii *Pk.*
Septoria Stachydis *R. & D.*
S. fusca *Pk.*
S. Stellariae *R. & D.*
S. Sibirici *Thum.*
S. solidaginicola *Pk.*
S. brevis *Pk.*
S. populicola *Pk.*
S. Smilacinae *E. & M.*
Pilidium graminicola *Pk.*
Gloesporium Robergei *Desm.*
G. septorioides *Sacc.*
G. Lindemuthianum *Sacc.*
Melanconium betulinum *Schm.*
M. dimorphum *Pk.*
Marsonia Populi *Sacc.*
Coryneum tumoricola *Pk.*
Scolecosporium Fagi *Lib.*
Pestalozzia Jefferisii *Ellis.*
Monilia Martini *S. & E.*
M. cinera *Bon.*
Ramularia Barbareae *Pk.*
Coniosporium punctoideum *Karst.*
Cladosporium Aphidis *Thum.*
C. Asparagi *Fr.*
C. brevipes *Pk.*

C. letiferum *Pk.*
Cercospora Acetosellae *Ellis.*
Macrosporium tomato *Cke.*
Pilacre orientalis *B. & Br.*
Graphium Sorbi *Pk.*
Isariopsis alborosella *Sacc.*
Fusarium Lycopersici *Sacc.*
Peziza truncicomes *Ger.*
P. alboviolascens *A. & S.*
Helotium episphaericum *Pk.*
Ascomyces letifer *Pk.*
A. rubrobrunneus *Pk.*
Erysiphe horridula *Lev.*
Calosphaeria ciliatula *Karst.*
Valsa Thujæ *Pk.*
V. exudans *Pk.*
Valsella adhaerens *Fckl.*
V. Laschii *Sacc.*
Diatrypella quercina *Nits.*
Melanconiella Decorahensis *Ellis.*
Sphaerella Pinsapo *Thum.*
S. minutissima *Pk.*
S. alnicola *Pk.*
S. Pontederiæ *Pk.*
Diaporthe farinosa *Pk.*
D. sulphurea *Fck.*
Valsaria Niesslii *Sacc.*
Leptosphaeria Asparagi *Pk.*
Massaria Pyrii *Otth.*
Pleospora Shepherdiae *Pk.*
Dothidella Alni *Pk.*
Lophiotrema vestita *Pk.*
L. parasitica *Pk.*

Not New to the Herbarium

Thalictrum purpurascens *L.*
Nelumbium luteum *Willd.*
Nymphæa odorata *Ait.*
Nuphar advena *Ait.*
Nasturtium lacustre *Gr.*
Arabis Drummondii *Gr.*
Cardamine hirsuta *L.*
Lepidium Virginicum *L.*
Lechea major *Mx.*
Polygala paucifolia *Willd.*
Lathyrus palustris *L.*
Lespedeza violacea *Pers.*
Geum rivale *L.*
Pyrus sambucifolia *C. & S.*
Amelanchier Canadensis *T. & G.*
Ribes Cynosbati *L.*
R. lacustre *Poir.*
R. prostratum *L'Her.*
Cornus paniculata *L'Her.*
Lonicera cærulea *L.*
Symphoricarpus racemosus *Mx.*
Aster acuminatus *Mx.*
A Radula *Ait.*
Solidago uliginosa *Nutt.*
Hieracium pilosella *L.*
Rhododendron Lapponicum *Wahl.*
Hyssopus officinalis *L.*
Polygonum tenue *Mx.*
Diapensia Lapponica *L.*
Carya alba *Nutt.*
Quercus palustris *Du Roi.*
Betula glandulosa *Mx.*
Salix Cutleri *Tuckm.*
Abies alba *Mx.*
Orchis spectabilis *L.*
Clintonia borealis *Raf.*
Streptopus roseus *Mx.*
S. amplexifolius *D. C.*
Polygonatum biflorum *Ell.*
Luzulu parviflora *Desv.*
Juncus articulatus *L.*
Scirpus Eriophorum *Mx.*
Scleria verticillata *Muhl.*
Carex alopecoidea *Tuckm.*
C. flava *L.*
C. longirostris *Torr.*
Agrostis vulgaris *With.*
Avena striata *Mx.*
Panicum capillare *L.*
P. Crus-galli *L.*
Setaria glauca *Bv.*
Triticum caninum *L.*
Aspidium Goldianum *Hook.*
Omphalia umbellifera *L.*
Pleurotus subareolatus *Pk.*

Crepidotus haerens *Pk.*
Boletus subaureus *Pk.*
Polyporus pubescens *Fr.*
P. cyphellaeformis *B. & C.*
Trametes mollis *Fr.*
Phlebia radiata *Fr.*
Odontia fimbriata *Fr.*
Peniophora neglecta *Pk.*
Clavaria pinea *Pk.*
Gloeosporium Martini *S. & E.*
Marsonia Juglandis *Sacc.*
Ramularia Plantaginis *E. & M.*
Cystopus Bliti *Lev.*
Peronospora Halstedii *Farl.*
P. gangliformis *De By.*
Trichothecium roseum *Lk.*
Pezicula acericola *Pk.*
Uncinula adunca *Lev.*
Hypoxylon atropunctatum *Schw.*
Diaporthe acerina *Sacc.*

(B.)

CONTRIBUTORS AND THEIR CONTRIBUTIONS

Mrs. M. M. Patton, Berne, N. Y.

Cynoglossum grande *Dougl.*
Brodiæa capitata *Benth.*

Mrs. I. B. Sampson, Albany, N. Y.

Sarracenia variolaris *Mx.*
Polygala nana *DC.*
Ruellia oblongifolia *Mx.*
Eriocaulon gnaphalodes *Mx.*

Hon. David Murray, Albany, N. Y.

Viola lutea *Sm.*
Arenaria verna *L.*
Silene inflata *Sm.*
Parnassia palustris *L.*
Saxifraga aizoon *Jacq.*
S. azoides *L.*
S. bryoides *L.*
Sedum acre *L.*
S. saxatile L.
Linnea borealis *Gron.*
Gnaphalium leontopodium *Willd.*
Hieracium pilosella *L.*
Loiseleuria procumbens *Desv.*

Prof. James Hall, Albany, N. Y.

Agaricus subareolatus *Pk.*

Charles E. Beecher, Albany, N. Y.

Lenzites sepiaria *Fr.*
Polyporus brumalis *Fr.*
P. sanguineus *L.*
Trametes hydnoides *Fr.*
Dædalea glaberrima *B. & C.*
Stereum versicolor *Fr.*
Hypochnus rubrocinctus *Ehr.*
Geaster minimus *Schw.*

George A. Rex, M.D., Philadelphia, Penn.

Hemiarcyria stipata *R.*
Arcyria dictyonema *R.*
A. Œrstedii *R.*
Trichia Jackii *R.*
Tilmadoche gyrocephalum *Mont.*
Physarum pulcherrimum *B. & C.*
P. Petersii *B. & C.*

Rev. A. B. Langlois, Pointe a la Hache, La.

Cytospora pallida *Ellis.*
Fusarium sarcochroum *Desm.*
Ailographum caespitosum *E. & E.*
Dinemasporium Langloisii *Ellis.*
Botryodiplodia diplocarpa *E. & E.*
Meliola sanguinea *Ellis.*
Valsa hylodes *Ellis.*

E. C. Howe, M.D., Lansingburg, N. Y.

Carex Buxbaumii *Wahl.*
Alopecurus geniculatus *L.*
Triticum caninum *L.*

H. L. Griffis, Binghamton, N. Y.

Polygala paucifolia *Willd.*

C. E. Smith, Philadelphia, Penn.

Baptisia tinctoria *R. Br.*
Polygala lutea *L.*
Linaria vulgaris *Mill.*

P. H. Dudley, New York, N. Y.

Trametes Pini *Fr.*
Polyporus versicolor *Fr.*

Prof. B. T. Galloway, Columbia, Mo.

Cercospora condensata *E. & K.*
C. Gymocladi *E. & K.*
C. rhuina *C. & E.*
C. Plantaginis *Sacc.*
C. Caulophylli *Pk.*
Cercospora Sanguinariae *Pk.*
Puccinia Seymeriae *Burrill.*
Septoria bacciligera *Wint.*
Gloeosporium Aceris *Cke.*
Marsonia Quercus *Pk.*

Prof. L. M. Underwood, Syracuse, N. Y.

Puccinia curtipes *Howe.*
Uromyces Trifolii *Fckl.*

Prof. T. H. McBride, Iowa City, Iowa.

Boletus sphærosporus *Pk.*

Julius A. Bisky, Flushing, N. Y.

Aster Radula *Ait.*
A. acuminatus *Mx.*
Mimulus moschatus *Dougl.*
Amianthium muscaetoxicum *Gr.*

Prof. F. Lamson Scribner, Washington, D. C.

Arundo Donax *L.*

A. P. Morgan, Preston, O.

Polyporus endocrocinus *Berk.*

Prof. William Trelease, St Louis, Mo.

Lycoperdon delicatum *B. & C.*
L. rimulatum *Pk.*
Dothidea viridispora *Cke.*

Prof. W. A. KELLERMAN, Manhattan, Kansas.

Lenzites abietina *Fr.*
Panus stipticus *Fr.*
Polyporus adustus *Fr.*
P. brumalis *Fr.*
P. sulphureus *Fr.*
P. applanatus *Fr.*
P. picipes *Fr.*
P. fraxinophilus *Pk.*
Trametes sepium *Berk.*
Craterellus cornucopioides *Fr.*
Stereum frustulosum *Fr.*
Merulius tremellosus *Schrad.*
Hydnum pallidum *C. & E.*
Tremella foliacea *Fr.*
Gloeosporium stenosporum *E. & K.*
Vermicularia Dematium *Fr.*
Darluca filum *Cast.*
Leptostroma vulgare *Fr.*
L. Actææ *Schw.*
Septoria Verbenæ *R. & D.*
S. gaurina *E. & K.*
S. Nolitangeris *Ger.*
S. Kalmicola *B. & C.*
S. Helianthi *E. & K.*
S. Verbascicola *B. & C.*
S. Polygonorum *Desm.*
S. Mimuli *E. & K.*
S. Pruni *Ellis.*
S. Cerastii *R. & D.*
S. Gei *Desm.*
S. sphærelloides *E. & K.*
S. xanthifolia *E. & K.*
S. Sisymbrii *Ellis.*
S. Specularіæ *B. & C.*
S. Erigerontis *Pk.*
S. lactucicola *E. & M.*
S. Cacaliæ *E. & K.*
Phyllosticta Asiminæ *E. & E.*
P. acericola *B. & C.*
P. smilacina *E. & M.*
P. Phaseoli *Sacc.*
P. Chenopodii *West.*
P. Ampelopsidis *E. & M.*
P. Labruscæ *Thum.*
P. Podophylli *Wint.*
P. Lycii *E. & K.*
Discosia maculæcola *Ger.*
Phoma glandicola *Desm.*
Stilbospora ovata *Pers.*
Coniothyrium herbarum *C. & E.*
Sphaeronema Persicae *Schw.*
Caeoma mercurialis *Lk.*
Coleosporium Campanulacearum *Fr.*
C. Sonchi *Tul.*
C. Senecionis *Fr.*
C. Agrimoniae *Bon.*
Uredo Smilacis *Schw.*
Trichobasis Crotonis *Cke.*
Chrysomyxa pyrolatum *Koenig.*
Synchytrium Anemones *Woron.*
S. mercurialis *Fckl.*
S. Taraxaci *DeBy.*
Roestelia penicillati *Fr.*
R. lacerata *Tul.*
Melampsora salicina *Lev.*
Æcidium impatientatum *Schw.*
Æ. Allii-ursini *Pers.*
Æ. Tragopogonis *Pers.*
Æ. Prenanthis *Pers.*
Æ. Euphorbiæ *Pers.*
Æ. leucospermum *DC.*
Æ. rubellum *Pers.*
Æ. Epilobii *DC.*
Æ. Œnotheræ *Pk.*
Æ. Caladii *Schw.*
Æ. Dicentrae *Trel.*
Æ. Ficariae *Pers.*
Æ. Violae *Schum.*
Æ. Callirrhoes *E. & K.*
Æ. amphigenum *E. & K.*
Æ. Sambuci *Schw.*
Æ. Verbenicola *E. & K.*
Æ. Ceanothi *E. & K.*
Uromyces appendiculatus *Lev.*
U. Zygadeni *Pk.*
U. Euphorbiæ *C. & P.*
U. Lespedezæ *Schw.*
U. Alchemillae *Pers.*
U. Peltandrae *Howe.*
U. Hyperici *Schw.*
Ustilago Carbo *Tul.*

U. Syntherismæ *Schw.*
Phragmidium obtusum *Lk.*
Gymnosporangium macropus *Schw.*
Puccinia Sorghi *Schw.*
P. Helianthi *Schw.*
P. Mariae Wilsoni *Clint.*
P. Amorphae *Curt.*
P. aculeata *Lk.*
P. Artemisiarum *Duby.*
P. Myrrhis *Schw.*
P. Xanthii *Schw.*
P. Malvastri *Pk.*
P. nigrescens *Pk.*
P. Polygonorum *Lk.*
P. solida *Schw.*
P. Chaerophylli *Purt.*
P. Menthæ *Pers.*
P. Silphii *Schw.*
Epicoccum sphærococcum *Berk.*
Sporocybe byssoides *Fr.*
Fusicladium fasciculatum *C. & E.*
Helminthosporium gracile *Wallr.*
H. interseminatum *B. & R.*
Macrosporium Maydis *C. & E.*
M. Solani *E. & M.*
M. Catalpæ *E. & M.*
Polythrincium Trifolii *Kze.*
Stachybotrys lobulata *Berk.*
Botrytis vulgaris *Fr.*
Pyricularia grisea *Sacc.*
Cylindrosporium Fraxini *E. & K.*
Microstroma leucospora *Niessl.*
Ramularia Desmodii *Cke.*
R. Astragali *E. & H.*
R. Grindeliæ *E. & K.*
R. rufomaculans *Pk.*
R. Tulasnei *Sacc.*
Entyloma Ranunculi *Bon.*
E. Physalidis *Wint.*
Cystopus cubicus *Lev.*
C. Bliti *DeBy.*
Peronospora sordida *Berk.*
P. parasitica *Tul.*
P. gangliformis *DeBy.*
P. alta *Fckl.*
P. Halstedii *Farl.*
P. Oxybaphi *E. & K.*
P. Arthurii *Farl.*
Cercospora Acalyphae *Pk.*
C. Ampelopsidis *Pk.*
C. Chenopodii *Fres.*
C. Plantaginis *Sacc.*
C. effusa *Ellis.*
C. Desmodii *E. & K.*
C. condensata *E. & K.*
Cercospora Gymnocladi *E. & K.*
C. chionea *E. & K.*
C. Isanthi *E. & K.*
C. rhuina *C. & E.*
C. microsora *Sacc.*
C. Teucrii *E. & K.*
Peziza capitata *Pk.*
P. floccosa *Schw.*
P. nivea *Fr.*
Ascobolus pilosus *Fr.*
Phacidium Pini *Schw.*
P. Medicaginis *Schw.*
Cenangium triangulare *Schw.*
Exoascus deformans *Berk.*
Chætomium chartarum *Cd.*
Chætomella perforata *E. & E.*
Podosphaeria Kunzei *Lev.*
Phyllactinia suffulta *Reb.*
Erysiphe lamprocarpa *Lev.*
Uncinula adunca *Lev.*
U. Ampelopsidis *Pk.*
U. macrospora *Pk.*
Microsphaeria Euphorbiae *B. & C.*
M. Platani *Howe.*
Diatrype disciformis *Fr.*
D. bullata *Fr.*
D. hypophlæa *B. & C.*
Xylaria Hypoxylon *Fr.*
Hypoxylon sassafras *Schw.*
H. atropunctatum *Schw.*
Rosellinia millegrana *Sacc.*
Dothidea perisporioides *B. & C.*
Stigmatea Robertiani *Fr.*
Diaporthe spiculosa *Fr.*
Phyllachora Ulmi *Fckl.*
Heliosphaeria patella *Grev.*
Linospora capreæ *Fckl.*

Venturia orbicula *C. & P.*
Zellermania yuccagena *E. & E.*
Zeptosphaeria doliolum *Pers.*
Pleonectria denigrata *Wint.*
Ophiobolus porphyrogonus *Sacc.*
Melanomma pulvispyrius *Fckl.*
Gnomonia setacea *Pers.*
Melanconis dasycarpa *E. & R.*
Sphaeria Caryaæ *C. & E.*
S. Arthuriana *Sacc.*
S. anguillida *C. & E.*
S. fulgida *C. & P.*
Sphærella decidua *E. & K.*
S. maculaeformis *Pers.*
S. sparsa *Awd.*
S. polystigma *Ellis.*
S. Campanulae *E. & K.*

E. J. Forster, M.D., Boston, Mass.

Hydnum auriscalpium *L.*
Scleroderma vulgare *Fr.*
Phyllosticta Sambuci *Desm.*
Sporidesmium lepraria *B. & Br.*
Phragmidium bulbosum *Schl.*
P. mucronatum *Lk.*
P. gracile *Grev.*
Triphragmium Ulmariae *Lk.*
Puccinia graminis *Pers.*
P. clandestina *Carm.*
P. Umbilici *Guep.*
Ustilago Carbo *Tul.*
Urocystis pompholygodes *Schl.*
Podisoma Sabinae *Fr.*
Roestelia lacerata *Tul.*
Sepedonium chrysospermum *Lk.*
Chaetomium elatum *Kze.*
Hypomyces aurantius *Tul.*
H. lateritius *Tul.*
H. rosellus *Tul.*
Sphaerotheca Castagnei *Lev.*
Sphaeria fimbriata *Pers.*
Sphaerella Buxi *DC.*
Stigmatea Robertiani *Fr.*

H. C. Gordinier, M.D., Troy, N. Y.

Ranunculus alismaefolius *Geyer.*
Lepidium campestre *L.*
Cerastium nutans *Raf.*
Arenaria lateriflora *L.*
Geranium Carolinianum *L.*
Trifolium hybridum *L.*
Mitella nuda *L.*
Chrysopsis graminifolia *Nutt.*
Polygonum tenue *Mx.*
Rumex brittanica *L.*
Blitum capitatum *L.*
Populus balsamifera *L.*
Salix candida *Willd.*
Thuja occidentalis *L.*
Orchis spectabilis *L.*
Cypripedium spectabile *Swartz.*
Carex Buxbaumii *Wahl.*
C. Muhlenbergii *Schk.*
C. alopecoidea *Tuck.*
C. aurea *Nutt.*
Alopecurus geniculatus *L.*
Glyceria acutiflora *Torr.*
Pardanthus Chinensis *Ker.*

J. Dunn, Albany, N. Y.

A piece of wood of silver maple, showing the scar of an inscribed cross, both in the wood and the bark.

W. S. Hayward, Sodus, N. Y.

A splinter of wood and fragments of stone broken by lightning.

(C.)

PLANTS NOT BEFORE REPORTED

GEUM MACROPHYLLUM, Willd.

Adirondack mountains, near the inlet of Lower Ausable pond. In the Manual this species is accredited to the base of the White mountains, Northern Michigan, Illinois and north-westward. Our newly discovered station is intermediate between the eastern and western localities recorded in the Manual. Flowering specimens were collected in June.

LACTUCA SCARIOLA, L.

Introduced, but apparently well established, in Clyde, Wayne county. September.

MIMULUS MOSCHATUS, Dougl.

Introduced. "Well established in a bog near Locust Valley," Long Island. *Julius A. Bisky.* August.

AMIANTHIUM MUSCÆTOXICUM, Gr.

Valley Stream, Long Island. July. *J. A. Bisky.* This is probably one of its most northern stations.

JUNCUS MILITARIS, Bigel.

Adirondack mountains. In Mud pond and Clear pond near Long lake. July. The bayonet rush grows in shallow water in these localities. Its panicle is not very conspicuous, and a superficial observer might easily mistake the plant for the great bulrush, *Scirpus validus*, which grows in similar situations. It spreads by creeping rootstocks which give origin to new plants, sometimes at less than an inch from the parent plant. The capillary submersed leaves noticed by Dr Robbins in flowing water were not seen in these stations, in which the plants grow in quiet water. The whitish membranous scales that subtend the reddish-brown or chestnut colored heads of flowers are noticeable by reason of the contrast in colors.

DISTICHIUM CAPILLACEUM, B. & S.

Wet rocks and precipices. Adirondack mountains, Cascadeville. June. The distichous arrangement of the leaves, characteristic of the genus, is not very conspicuous in this moss, which at first sight somewhat resembles *Dicranella heteromalla*.

CALICUM EUSPORUM, Nyl.

Bark of dead balsam, *Abies balsamea*. Chapel pond, Adirondack mountains. June. This rare lichen has but recently been detected in this country. Mr. Willey informs me that he first found it about a year ago in the White mountain region.

COLLYBIA FULIGINELLA, N. sp.

Pileus convex or nearly plane, sometimes irregular or undulate on the margin, glabrous, even, fuliginous-brown, flesh white; lamellae, rather narrow, close, rounded behind, adnexed or nearly free, white; stem equal or slightly tapering upward, subfibrillose, stuffed or hollow, colored like the pileus or a little paler, white tomentose at the base; spores subelliptical, .0003 to .00035 inch long, .0002 to .00025 broad, usually containing a single large nucleus.

Pileus 1.5 to 2.5 inches broad, stem 1.5 to 2 inches long, 2 to 3 lines thick.

Under or near arbor-vitae, *Thuja occidentalis*. Elizabethtown, Essex county. September.

In size and shape this species resembles *Collybia dryophila*, but its color, which closely resembles that of *Lacterius lignyotus*, is far different.

CLITOPILUS SUBVILIS, N. sp.

Pileus thin, centrally depressed or umbilicate, with the margin decurved, hygrophanous, dark-brown and striatulate when moist, grayish-brown and silky-shining when dry; lamellae subdistant, adnate or slightly decurrent, whitish when young, then flesh-colored; stem slender, brittle, rather long, stuffed or hollow, glabrous, colored like the pileus or a little paler; spores irregular, angular, .0003 to .0004 inches long; odor weak or none, taste farinaceous.

Pileus 8 to 15 lines broad, stem 1.5 to 3 inches long, 1 to 2 lines thick.

Damp soil in thin woods. Karner, Albany county. October.

The species seems to be closely related to *Clitopilus vilis*, from

which I have separated it because of its smooth and shining (not flocculose and opaque), pileus and its farinaceous taste. It was discovered in 1884, growing, in company with *Entoloma rhodopolium* in such a way that it was taken to be a variety of it, and it was referred to that species under the name var. *umbilicatum*. This year it was found plentifully in the same locality, but entirely unaccompanied by *E. rhodopolium*. A more careful study of it leads me to the conclusion that it is a distinct species.

HEBELOMA GLUTINOSUM, Lind.

Among fallen leaves and on half buried decaying wood, in thin woods. Conklingville. September.

In wet weather the gluten is sufficiently copious to drip from the pileus.

CORTINARIUS SUBFERRUGINEUS, Fr.

Thin woods. Conklingville. September.

POLYPORUS DRYOPHILUS, Fr.

At the base of oak trees. Conklingville. July.

POLYPORUS SINUOSUS, Fr.

Decaying wood of maple, *Acer saccharinum*. Forestburgh, Sullivan county. September. The species is remarkable for and easily known by its sweet and agreeable fragrance, which has been likened to that of licorice.

POLYPORUS RADICULOSUS, N. sp.

Resupinate, effused, thin, soft, tender, orange-yellow, the mycelum creeping in and over the wood, silky-tomentose, at first white, then yellow, forming numerous yellow branching root-like strings or ribs which are more or less connected by a soft, silky tomentum; pores rather large, angular, at first shallow, sunk in the mycelium, the dissepiments becoming more elevated, thin and fragile; spores elliptical, .0002 to .00025 inch long, .00012 to .00016 broad.

Half buried chips of poplar. *Populus tremuloides*. Gansevoort. September.

The species is allied to *P. Vaillantii*, in its peculiar rhizomorphoid strings of mycelium, but from this it differs decidedly in its color and texture. In these respects it approaches *P. bombycinus*, of which it may possibly be a peculiar variety. It is very

destructive to the wood on which it grows, causing it to become soft, brittle and even friable.

HYDNUM VELATUM, B. & C.

Decaying wood of poplar, *Populus tremuloides*. Gansevoort. September.

HYDNUM SUBFUSCUM, N. sp.

Resupinate, thin, soft, the margin and subiculum beneath white, tomentose, sometimes extended into branching strings of mycelium, the upper surface of the subiculum pale yellowish-brown or dingy-isabelline, when magnified, appearing as if sprinkled with minute shining particles; aculei slender, subulate, very acute, white when young, then with white tips or wholly colored like the subiculum.

Decaying wood of deciduous trees. Conklingville. September. In *H. himantia*, which, in some respects, this species resembles the teeth are described as obtuse and pulverulent.

HYDNUM CARBONARIUM, N. sp.

Resupinate, very thin, at first floccose-pruinose and white, then smoky-brown, sometimes retaining a white margin; aculei at first short, then longer, subulate or cylindrical, minutely ciliate at the apex, whitish when young, then smoky-brown.

Charred wood. Elizabethtown. September. The species is easily recognized by its peculiar color and by the ciliate or setulose tips of the teeth. It appears as if it had been smoked or scorched.

IRPEX AMBIGUUS, N. sp.

Resupinate, adnate; subiculum very thin, flocculose-pruinose, white, becoming pallid with age; aculei oblique, somewhat united at the base, minute, very variable, subulate and entire, or compressed, acute, truncate, branched, incised or subserrate, white when young, becoming pallid with age.

Decaying beech wood and bark. Adirondack mountains. September.

It forms small irregular or interrupted patches. To the naked eye it resembles *Hydnum pallidum*, but the teeth are more or less united at the base, thus requiring it to be placed in the genus Irpex. Scarcely any two of them are exactly alike.

POROTHELIUM PAPILLATUM, N. sp.

Effused, very thin, flocculose-pruinose, white when young, soon pallid or isabelline, subwaxy and often rimose, the margin subin-

determinate; verrucae minute, subdistant, at first a limpid globule resting on the subiculum, then slightly prominent, papilliform, colored like the subiculum and crowned with a limpid globule which varies in color from hyaline to amber.

Decorticated wood of poplar, *Populus tremuloides*. Elizabethtown. September. It forms patches several inches in extent. It is apparently related to *P. Friesii*, but it is not membranous, the warts are colored like the subiculum and are not immersed in it.

THELEPHORA DENDRITICA, Berk.

Overspreading the hymenium of effete *Polyporus applanatus*. Adirondack mountains. September.

STEREUM ABIETINUM, Pers.

Prostrate trunk of spruce, *Abies nigra*. Cascadeville, Adirondack mountains. June.

Our specimens agree with the description of the species to which we have referred them, but they present some interesting characters not mentioned in that description. It often happens that great perplexity arises because of the incomplete descriptions of some of the older authors. A careful examination of our specimens shows the presence of both setae and metuloids, the latter much more numerous than the former. Thus this species does for Stereum, Hymenochæte and Peniophora what *Dædalea confragosa* does for Dædalea, Trametes and Lenzites, as was shown in the thirtieth report. It sets at naught the characters used in distinguishing these genera, and bids defiance to the generic limits assigned in the botanies. To the naked eye, the hymenium in our specimens has a somewhat "velvety pruinose" appearance, but when examined by the microscope it is found to be abundantly furnished with projecting setiform bodies, some of which are smooth and colored, as in Hymenochæte; others are colorless and rough or minutely warted, as in Peniophora. Sometimes a single one is colorless and warted in the upper part, colored and smooth in the lower. And as if this was not enough of confusion to our former notions, the hymenium, though dry, becomes rimose as in many species of Corticium. The fungus sometimes forms patches several inches in extent by the confluence of individuals. It is nearly or quite one line thick, the intermediate stratum being

composed of erect fibres. Though dry, it is not very tough. The spores are oblong or subfusiform .0005 to .0007 inch long, .0002 broad.

HYMENOCHÆTE TENUIS, N. sp.

Resupinate, very thin, even, forming elongated, more or less confluent, dark ferruginous patches, concolorous on the determinate margin, inseparable, rimose; setae acute, .0012 to .0025 inch long.

Decorticated wood of arbor-vitae, *Thuja occidentalis*. Cascadeville. June.

CLAVARIA KROMHOLZII, Fr.

Open woods. Brewerton and Adirondack mountains. September.

PHYLLOSTICTA LYCOPERSICI, N. sp.

Spots large, suborbicular, cinereous; perithecia minute, brown or blackish, opening by a single or sometimes by two pores; spores abundant, oblong or elliptical, .00025 to .0003 inch long, .0001 to .00012 broad.

Fruit of tomato, *Lycopersicum esculentum*. Menands, Albany county. July.

PHYLLOSTICTA PHASEOLINA, Sacc.

Leaves of cultivated bean, *Phaseolus vulgaris*. Menands. September.

PHYLLOSTICTA CARYÆ, N. sp.

Spots large, irregular, often confluent, at first yellowish, then brown, sometimes becoming grayish in the center; perithecia minute, .004 inch broad, punctate, epiphyllous; spores irregularly elliptical, .0002 inch long, .00008 broad.

Living leaves of hickory, *Carya alba*. Piffard. August.

PHYLLOSTICTA PHOMIFORMIS, Sacc.

Living leaves of white oak, *Quercus alba*. Sandlake, Rensselaer county. September.

PHYLLOSTICTA TUMORICOLA, N. sp.

Spots suborbicular, arid, pallid with a reddish or reddish-brown margin, apparently caused by insects; perithecia amphigenous or epiphyllous minute, .005 to .007 inch broad, depressed, brownish; spores oblong or narrowly elliptical, colorless, .0004 to .0005 inch long, .0002 to .00025 broad.

Living gall-spotted leaves of white oak, *Quercus alba*. Karner. October. In *P. phomiformis* the spores are much larger than in

this species. The spots are centrally punctured and appear to have been produced by the stings of insects.

PHYLLOSTICTA POPULINA, Sacc. v. PARVA n. var.

Living or languishing leaves of necklace poplar, *Populus monilifera*. Menands. October.

Spots very small, orbicular, white, with a brown border; perithecia one to four on a spot.

PHYLLOSTICTA SPERMOIDES, N. sp.

Spots suborbicular, brown or cinereous with a brown border, sometimes confluent; perithecia minute, .0014 to .0025 inch broad, numerous, hypophyllous, blackish; spores minute, cylindrical, .0002 inch long.

Living leaves of wild grape vine, *Vitis riparia*. Gansevoort. September.

PHYLLOSTICTA FAGINEA, N. sp.

Spots suborbicular, small, often seriate or subconfluent, and arranged in rows parallel to the veins of the leaf, cinereous or reddish-gray, with a reddish-brown border or wholly reddish-brown, subferruginous beneath; perithecia few, epiphyllous, minute, .003 inch broad, black; spores ovate or elliptical, .0003 to .0004 inch long, .0002 to .00025 broad.

Living leaves of beech, *Fagus ferruginea*. Argusville and Elizabethtown. September.

PHYLLOSTICTA VAGANS, N. sp.

Spots none; perithecia minute, .003 to .0035 inch broad, amphigenous, numerous, occupying the whole leaf, black; spores very minute, spermatoid, .00012 inch long, .00004 broad, sometimes oozing out and forming a white globule.

Dead leaves of *Smilacina racemosa*. Conklingville. September.

This is a very anomalous species. But for the very short minute spores, it would accord better with Septoria than Phyllosticta.

PHYLLOSTICTA FATISCENS, N. sp.

Spots rather large, suborbicular, pallid, generally marked by one or more elevated concentric lines, at length cracking around the margin and separating, wholly or in part, from the uninjured tissues of the leaf; perithecia minute, .004 inch broad, epiphyllous,

at first pale, then brownish; spores oblong, straight or slightly curved, .00025 to .0004 inch long, .00012 to .00016 broad.

Living leaves of yellow pond lily, *Nuphar advena*. Argusville, Schoharie county. July.

PHYLLOSTICTA SYMPHORICARPI, West.

Living leaves of snowberry, *Symphoricarpus racemosus*. Canajoharie, Montgomery county. July.

PHOMA MAGNIFRUCTA, N. sp.

Perithecia small, .005 to .007 inch broad, scattered, subglobose, erumpent, black; spores oblong-fusiform, .0009 to .0012 inch long, .0003 to .0004 broad; sporophores short.

Cone scales of arbor-vitae, *Thuja occidentalis*. Keene Essex county. June.

This species is readily distinguished from others inhabiting cone scales by its large spores.

PHOMA LEGUMINUM, West.

Legumes of locust, *Robinia pseudacacia*. Piffard. August.

PHOMA OLERACEA, Sacc. v. DIPSACI Sacc.

Dead stems of teasel, *Dipsacus sylvestris*. Wallington, Wayne county. September.

PHOMA EUPYRENA Sacc.

Dead potato stems. Menands. October.

PHOMA POPULI, N. sp.

Perithecia minute, .003 to .004 inch broad, epiphyllous, gregarious, black, opening by a large pore; spores cylindrical, straight or slightly curved, .0006 to .0008 inch long, .00012 broad.

Dead leaves of poplar, *Populus tremuloides*. Elizabethtown. September.

PHOMA HERBARUM, West.

Dead stems of wormwood, *Artemisia vulgaris*. Port Henry. June.

PHOMA CASTANEA, N. sp.

Perithecia numerous, surrounding the branch, .011 to .014 inch broad, erumpent, black; spores minute, oblong or cylindrical, .00025 to .0003 inch long, .00006 to .00008 broad; sporophores short.

Dead branches of chestnut, *Castanea vesca*. Sandlake. May.

APOSPHÆRIA CONICA, Sacc.

Decaying oak wood. Piffard. August.

CYTOSPORA GRANDIS, N. sp.

Pustules large, two to three lines broad, ellipsoid or suborbicular, scar-like, ferruginous from the ruptured bark; loculi numerous; spores minute, curved, .0002 inch long.

Dead bark of sumach, *Rhus typhina*. Gansevoort. September.

HAPLOSPORELLA PINI, N. sp.

Perithecia valsoid, caespitose, three to five in a cluster, sunk in the inner bark, erumpent; spores globose or subelliptical, colored, .0005 to .0006 inch long.

Dead bark of white pine, *Pinus Strobus*. Elizabethtown. June

DIPLODIA PAUPERCULA, B. & Br.

Dead branches of elder, *Sambucus Canadensis*. Adirondack mountains. June.

DIPLODIA ASPARAGI, N. sp.

Perithecia gregarious, subglobose, minute, opening by a papillate pore, black; spores elliptical, colored, .0008 to .001 inch long, .0005 broad.

Dead stems of asparagus. Menands. October.

STAGONOSPORA CHENOPODII, N. sp.

Spots few, large, brown or yellowish-brown; perithecia minute, .004 to .005 inch broad, black; spores oblong, obtuse, biseptate or triseptate, constricted at the septa, colorless, .0008 to .001 inch long, .0003 to .0004 broad.

Living leaves of goose-foot, *Chenopodium album*. Menands. August.

SEPTORIA STACHYDIS, R. & D.

Living leaves of hedge nettle, *Stachys aspera*. Port Kent. June.

SEPTORIA FUSCA, N. sp.

Spots blackish-brown, indefinite, occupying the lobes of the leaves or their margins; perithecia epiphyllous, black; spores filiform, straight, slightly curved or flexuous, .0016 to .002 inch long.

Living or languishing leaves of wormwood, *Artemisia vulgaris*. Port Henry. June.

It differs from *S. Artemisiae* in its indefinite spots and longer spores.

SEPTORIA STELLARIÆ, R. & D.

Living or languishing leaves of chickweed, *Stellaria media*. Aden Lair, Adirondack mountains. June.

SEPTORIA SIBIRICI, Thum.

Living leaves of fetid currant, *Ribes prostratum*. Adirondack mountains. September.

SEPTORIA SOLIDAGINICOLA, N. sp.

Spots small, angular, white or whitish on the upper surface, darker beneath, surrounded by a brown or reddish brown border; perithecia few, usually one or two on a spot, epiphyllous, subglobose, blackish; spores linear, straight, subacute, simple, .001 to .0016 inch long, .00016 broad.

Living leaves of goldenrod, *Solidago arguta*. Cobble hill, near Elizabethtown. September.

Distinguished from *S. Solidaginis* by its longer continuous spores, which are neither septate nor nucleate.

SEPTORIA BREVIS, N. sp.

Spots none; perithecia scattered, epiphyllous, minute, .003 to .004 inch broad, opening widely, black; spores short, .0004 to .0005 inch long, .00006 broad, straight or slightly curved.

Dead leaves of *Solidago virgaurea* v. *alpina*. Mt. Marcy. June.

Distinct from other species inhabiting solidago, by its very short spores, which resemble somewhat the allantoid spores of species of Valsa.

SEPTORIA POPULICOLA, N. sp.

Spots suborbicular, reddish or brownish red with a narrow blackish border on the upper surface, grayish on the lower; perithecia hypophyllous, few, pale, opening widely; spores filiform, curved, two to four-septate, .0025 to .003 inch long, .00012 to .00016 broad.

Living leaves of balm of Gilead, *Populus balsamifera*. Keene. June.

Distinguished from other species found on poplar by its long pluriseptate spores. The perithecia are but slightly developed.

SEPTORIA SMILACINÆ, E. & M.

Languishing leaves of *Smilacina racemosa*. Sandlake. September.

PILIDIUM GRAMINICOLA, N. sp.

Perithecia minute, .008 to .014 inch broad, depressed, erumpent, orbicular or hysteriform, membranous, opening widely, black, the disk whitish, the mouth laciniate-dentate; spores oblong or subfusiform, colorless, triseptate, .0012 to .0016 inch long, .0004 to .00045 broad; sporophores short, colorless.

Dead leaves of blue joint, *Calamagrostis Canadensis*. Mount Marcy. June.

GLŒOSPORIUM LINDEMUTHIANUM, Sacc.

Living bean pods, especially of the butter or wax bean. Menands. August.

An injurious fungus that produces brown spots on the pods, thus spoiling their appearance and diminishing their value.

GLŒOSPORIUM SEPTORIOIDES, Sacc.

Living leaves of white oak, *Quercus alba*. Gansevoort. September.

GLŒOSPORIUM ROBERGEI, Desm.

Living leaves of water beech, *Carpinus Americana*. Gansevoort. September.

MELANCONIUM BETULINUM, Schm.

Dead bark of white birch, *Betula populifolia*. Menands. September.

Distinguished from *M. bicolor* by its longer spores.

MELANCONIUM DIMORPHUM, N. sp.

Pustules small, subcutaneous, slightly prominent, subconical, black, containing a small white stroma; spores of two forms, one narrow, cylindrical, straight or curved, .0003 to .0004 inch long, .00008 broad, the other oblong, elliptical or subfusiform, colored, .0004 to .0005 inch long, .0002 to .00025 broad, oozing out in a black mass or in tendrils.

Dead branches of alder, *Alnus viridis*. Adirondack mountains. June.

Remarkable for the two kinds of spores. In some pustules the broader spores are more numerous, in others the narrower ones, but both kinds were found in all the pustules examined. Can the narrow ones be broken or effete sporophores?

MARSONIA POPULI, Sacc.

Living leaves of *Populus monilifera*. Menands. July.

CORYNEUM TUMORICOLA, N. sp.

Spots scattered, suborbicular, pallid with a reddish-brown border, apparently produced by insects; heaps epiphyllous, minute, dot-like, unequal, black; spores oblong, triseptate, colored, .0004 to .0005 inch long, .00016 broad, at length breaking from the sporophores.

Living leaves of elm, *Ulmus Americana*. Adirondack mountains. July. The spots in this instance, as in that of *Phyllosticta tumoricola*, appear to be due to the stings of insects. A central aperture or puncture is visible in the spot and the fungus occurs in only a part of them.

SCOLECOSPORIUM FAGI, Lib.

Dead branches of alder, *Alnus incana*. Elizabethtown. September.

The typical form occurs on beech, but I find no essential differences in the form on alder. *Massaria macrosperma*, the ascigerous form, has not yet been observed with us.

PESTALOZZIA JEFFERISII, Ellis.

Leaves of wild grape, *Vitis riparia*. Gansevoort. September.

The fungus occurs on spots which are apparently produced by a sterile Rhytisma.

MONILIA MARTINI, E. & S.

Old corn cobs. Menands. September.

MONILIA CINEREA, Bon.

On plums. Sandlake. Closely related to *Monilia fructigena*, with which the species has been united by some authors.

RAMULARIA BARBAREÆ, N. sp.

Spots suborbicular, arid, white, generally bordered by a slightly thickened brown line; flocci amphigenous, either short and branched or longer and simple; spores oblong or cylindrical, often catenulate, rarely uniseptate, .0004 to .0009 inch long, .00012 to .00016 broad.

Living leaves of winter cress, *Barbarea vulgaris*. Highland Mills and Port Henry. June.

This species is closely related to *R. Armoraciae*, from which it may be distinguished by the whiter mostly margined spots, the shorter hyphae and the catenulate spores.

CONIOSPORIUM PUNCTOIDEUM, Karst.

Decorticated wood of arbor vitae, *Thuja occidentalis*. Adirondack mountains. June.

CLADOSPORIUM APHIDES, Thum.

Dead aphides of *Phragmites communis*. Bergen Swamp. June.

CLADOSPORIUM ASPARAGI, Fr.

Dead stems of asparagus. Menands. October.

CLADOSPORIUM BREVIPES, N. sp.

Spots suborbicular, cinereous; flocci densely caespitose, short, .001 to .0015 inch long, dark olivaceous, almost black in the mass, amphigenous, septate; spores terminal, elliptical, .0005 to .0006 inch long, .0003 to .0004 broad.

Living leaves of white oak, *Quercus alba*. Menands. July. This species forms minute compact tufts, so distinct and well defined that they might easily be mistaken for perithecia.

CLADOSPORIUM LETIFERUM, N. sp.

Spots dark brown, irregular, large, often involving the whole leaf; tufts epiphyllous, subeffused, olive green, the hyphae very short, almost obsolete; spores oblong-pyriform, uniseptate or biseptate, slightly constricted at the septa, .0008 to .0012 inch long, .0003 broad.

Living leaves of poplar, *Populus tremuloides*. Keene. June.

This fungus often kills the leaves it attacks. When the spores have a single septum the two cells are unequal; when they have two septa the middle cell is generally larger than the terminal ones. The species differs from *C. Asteroma* in the shape and character of the spores and in its more effused habit.

CERCOSPORA ACETOSELLÆ, Ellis.

Living leaves of yellow dock, *Rumex crispus*. Elizabethtown. September.

Our specimens differ slightly from the type and may be designated variety *maculosa*. Spots numerous, small, suborbicular, grayish,

urrounded by an elevated margin and a brownish-red border; pores at length with one or two septa.

MACROSPORIUM TOMATO, Cke.

Decaying fruit of tomato. Menands. October.

PILACRE ORIENTALIS, B. & Br.

Dead bark of alders, *Alnus incana*. Elizabethtown. September.

In our specimens the sporiferous branches are sometimes elongated and flexuous and the young plant wholly white, in which respects they differ from the typical form of the species. But the stem soon becomes cinereous and finally the whole plant is umber-brown. Young plants sometimes grow from the base of old ones, sometimes from the head.

GRAPHIUM SORBI, N. sp.

Spots generally small, one or two lines broad, orbicular, definite, reddish-brown; stems hypophyllous, rather stout, equal or slightly tapering upward, the component flocci diverging and colorless at the apex; spores oblong, hyaline, .0008 to .001 inch long, .00025 to .0008 broad, sometimes with two to four minute nuclei.

Living leaves of mountain ash, *Pyrus Americana*. Adirondack mountains. July.

ISARIOPSIS ALBOROSELLA, Sacc.

Living or languishing leaves of chickweed, *Cerastium vulgatum*. Keene. July.

I find only uniseptate spores in our specimens.

FUSARIUM LYCOPERSICI, Sacc.

Fruit of the tomato. Menands. August.

A malady affects the fruit of the tomato. In the vicinity of Albany, the past season, the first ripening tomatoes were found almost invariably to be soft and decaying. A brown or discolored spot, usually located at the flowering end of the fruit, appears to be the origin and center of the disease. This spot often makes its appearance while the fruit is yet green. This Fusarium soon develops on this spot, appearing in the form of minute pallid dots, or in more effused patches which are of a pinkish or an orange hue. With advancing age it assumes a more or less brownish hue. If the affected tomato be cut open its inner flesh often exhibits a

peculiar purplish tint. In a short time the white flocculent threads of the fungus appear on the cut surface, soon to be followed by the more waxy and colored patches of spores, thus showing that the mycelium has permeated the diseased flesh of the tomato. The affected tomatoes become very watery and any surface on which a diseased tomato lies, soon becomes wet from the exuding juices. From the constancy with which this fungus appears in connection with the disease, it would appear that it might be regarded as the cause of the decay, but there are circumstances that point to some more subtle agent of the mischief. Further investigation is necessary to determine satisfactorily the source of the disease.

PEZIZA TRUNCICOMES, Ger.

Decaying prostrate trunks of deciduous trees. Knowersville, Albany county. May.

PEZIZA ALBOVIOLASCENS, A. & S.

Old chestnut rails. Conklingville. September.

HELOTIUM EPISPHÆRICUM, N. sp.

Receptacle minute, .012 to .02 inch broad, gregarious, subsessile, at first subhyaline, then reddish-yellow, the disk nearly plane, asci subcylindrical; spores oblong or lanceolate, .0002 to .00025 inch long, .0001 to .00012 broad.

On old *Hypoxylon Morsei*. Elizabethtown. September.

It resembles *H. citrinum* in habit, but is very much smaller.

ASCOMYCES LETIFER, N. sp.

Indefinite, hypophyllous, often occupying the whole lower surface of the leaf and suffusing it with a glaucous bloom; asci cylindrical, obtuse or subtruncate, .0016 to .002 inch long, .0006 to .0008 broad; spores minute, varying from narrowly elliptical to subglobose, .00016 to .0002 inch long, .00008 to .00012 broad.

Living leaves of mountain maple bush, *Acer spicatum*. Elizabethtown. June.

The species is very distinct from *A. polysporus*, which forms definite spots. The attacked leaves soon turn black, wither and die. Sometimes all the leaves on a branch are affected and the fungus then causes a veritable blight.

ASCOMYCES RUBROBRUNNEUS, N. sp.

Spots definite, variable, small and suborbicular or large and irregular, sometimes confluent, usually concave above, convex below, dull reddish-brown above, paler below; asci oblong, truncate at the apex, .002 to .003 inch long, .0006 to .0009 broad; spores minute, subelliptical, .00012 to .00016 inch long, .0006 to .0008 broad.

Living leaves of red oak, *Quercus rubra*. Sandlake. September.

In some respects this approaches *A. alutarius*, from which the color of the spots, larger asci and different shape of the spores will distinguish it.

ERYSIPHE HORRIDULA, Lev.

Abundant on corn gromwell, *Lithospermum arvense*. Port Henry. June.

Our specimens were too young when collected to show the spore characters, and are to this extent doubtful.

CALOSPHÆRIA CILIATULA, Karst.

Dead trunks and branches of white birch, *Betula populifolia*. Menands. September.

VALSA THUJÆ, N. sp.

Pustules scattered, slightly prominent, closely covered by the epidermis; perithecia nestling in the inner bark, subcircinate, five to ten in a pustule; asci oblong-clavate, .0014 to .0016 inch long; spores allantoid, .0004 to .0005 inch long, .00008 to .0001 broad.

Dead branches of arbor vitae, *Thuja occidentalis*. Elizabethtown. September.

VALSA EXUDANS N. sp.

Perithecia collected in a cortical stroma, thin, crowded, angular, closely covered by the pustulately elevated, irregularly ruptured epidermis, ostiola obscure or concealed beneath the defiled epidermis; asci very slender, cylindrical, .0016 inch long, .00016 broad; spores minute, oblong, straight, colored, .0002 inch long, oozing out and staining the surface of the matrix.

Dead bark of alders, *Alnus incana*. Elizabethtown. September.

This is an anamolous species and does not agree well with the generic characters. The straight, colored and oozing spores are unusual and peculiar features.

VALSELLA ADHERENS, Fckl.

Corticated trunk and branches of white birch, *Betula populifolia* Sandlake. September.

In our plant the disk is often whitish or grayish from the adhering remains of the epidermis; the perithecia are five to twelve in a pustule and the spores are colored in the mass. It is apparently a variety of the species and may be called var. *Americana*.

VALSELLA LASCHII, Sacc.

Dead whitened twigs of *Acer spicatum*. Port Henry. June.

In our specimens the black stroma is apparent through the translucid epidermis, and the white disk, though small, is plainly seen by contrast. The asci are very broad, .0016 to .002 inch long, .0005 to .0006 broad. This form may be designated as var. *acerina*.

DIATRYPELLA QUERCINA, Nits.

Dead branches of thorn, *Crataegus tomentosa*. Elizabethtown. September.

Although occurring on thorn branches, there does not appear to be any good characters for separating this fungus from the species to which I have referred it.

SPHÆRELLA MINUTISSIMA, N. sp.

Perithecia very numerous, occupying the whole lower surface of the leaf, very minute, .002 to .0025 inch broad, veiled by the epidermis, black; asci oblong or slightly narrowed toward the apex, .0016 to .002 inch long, .0003 to .0004 broad; spores crowded, oblong, straight, obscurely septate in the middle, .0006 to .0007 inch long, .00016 broad.

Dead leaves of alder, *Alnus incana*. Adirondack mountains. June.

The perithecia are scarcely visible to the naked eye. The affected leaves remain on the branches through the winter. They had not yet fallen in June.

SPHÆRELLA ANLICOLA, N. sp.

Perithecia small, .0035 to .0045 inch broad, hypophyllous, clustered or scattered, naked, black; asci oblong or subclavate, .002 to .0025 inch long, .0005 to .0006 broad; spores crowded, lanceolate,

niseptate, often slightly curved, .0009 to .0011 inch long, .00016 road.

Dead leaves of alder, *Alnus viridis*. Mt. Marcy. June. The pores are narrowed toward one end and septate in the middle. The species is evidently distinct from *S. Alni viridis* in its larger xposed perithecia, in the shape of its spores and in wanting a ematiaceous stroma. Apparently the same species was found near Elizabethtown, but without fruit.

SPHÆRELLA PONTEDERIÆ, N. sp.

Spots rather large, six to ten lines long, oblong or elliptical, ometimes confluent, brown above, blackish brown or grayish rown below; perithecia minute, .003 inch broad, hypophyllous, lack; asci oblong or subfusiform, .002 to .0025 inch long, .0005 road; spores crowded or biseriate, oblong-clavate, uniseptate, ometimes quadrinucleate, .0006 to .0008 inch long, .0002 to .00025 road.

Languishing leaves of pickerel weed, *Pontederia cordata*. Whitehall, Washington county. September.

Apparently related to *S. Caladii*, but with longer spores and ifferent spots.

SPHÆRELLA PINSAPO, Thum.

Fallen leaves of arbor-vitae. Port Henry. June.

DIAPORTHE SULPHUREA, Fckl.

Dead stems and branches of hazelnut, *Corylus rostrata*. Ganseoort. September.

This species is easily recognized by the beautiful yellow spurious troma that extends everywhere under the epidermis of the affected ranches.

DIAPORTHE (CHOROSTATE) FARINOSA, N. sp.

Stroma somewhat pulverulent or mealy, dull buff colored, formed f the slightly changed inner bark, erumpent in a minute slightly xserted disk; perithecia valsoid, irregularly circinating, generally our to ten in a circle, the clusters subconfluent, ostiola black, otting the prominent pulverulent buff colored or at length brownish isk; asci subcylindrical, .0024 to .003 inch long, .00035 to .0004 road; spores crowded or biseriate, oblong or subfusiform, uniseptate, enerally quadrinucleate, .0006 to .0008 inch long, .00016 to .0002 road.

Dead branches of basswood, *Tilia Americana*. Argusville. July.

This species approaches *D. furfuracea* in its pulverulent stroma, but it differs in its prominent disk, which renders the affected branches rough to the touch, and in its smaller quadrinucleate crowded or biseriate spores. From *D. velata* it is easily separated by the entire absence of any black circumscribing line or blackened surface. It evidently belongs to the subgenus Chorostate, but the clusters of perithecia are so numerous and so closely and almost confluently placed that they form an almost continuous stratum which surrounds the branch and extends long distances under the epidermis.

MELANCONIELLA DECORAHENSIS, Ellis.

Dead bark of white birch, *Betula populifolia*. Gansevoort. September.

In the typical form the disk is described as "sordid gray." In our specimens, both it and the stroma are yellowish green and pulverulent. On the smaller branches the disk is smaller and the ostiola are less prominent than on the larger ones. When the epidermis is torn away the perithecia adhere to it. The young spores are colorless and subacute at each end. The mature ones are colored, obtuse and constricted at the septum.

The conidia ooze out and form orbicular black patches one to two lines broad. These are very conspicuous by reason of the contrast between their color and the white color of the matrix.

VALSARIA NIESSLII, Sacc.

Dead bark of white birch, *Betula populifolia*. Menands. September.

LEPTOSPHÆRIA ASPARAGI, N. sp.

Perithecia broadly conical, .01 to .014 inch broad, at first covered by the pierced epidermis, then naked, black; asci clavate or cylindrical, short pedicellate, .003 to .004 inch long, .00045 to .0006 broad; spores oblong or subfusiform, crowded, .0008 to .0012 inch long, .0003 broad, at first colorless and triseptate, then slightly colored and five-septate, constricted at the septa.

Dead stems of asparagus. Menands. October.

MASSARIA PYRI, Otth.

Bark of pear and apple trees. Albany. May.

PLEOSPORA SHEPHERDIÆ, N. sp.

Perithecia scattered, small, .014 to .018 inch broad, covered by the epidermis, erumpent, black; asci cylindrical, .006 to .008 inch long, .0006 broad; spores uniseriate, oblong, generally triseptate, rarely five-septate, with one or two longitudinal septa, constricted in the middle, colored, .0008 to .001 inch long, .0003 to .0004 broad.

Dead branches of *Sherpherdia Canadensis*. Port Henry. June.

DOTHIDELLA ALNI, N. sp.

Stroma orbicular, one to three lines broad, thin, convex and black above, concave, brown or grayish-black and papillosely rugulose below; asci cylindrical; spores ovate-elliptical, obscurely uniseptate near one end, colorless, .0006 to .0008 inch long, .0003 to .00035 broad.

Dead leaves of *Alnus viridis*. Mt. Marcy. June.

The spores are very unequally divided, the smaller cells appearing like an umbo.

LOPHIOTREMA VESTITA, N. sp.

Perithecia closely gregarious, small, .014 to .02 inch broad, sunk in the wood, erumpent, conical, clothed with a slight tawny-ferruginous pulverulent tomentum, ostiola naked, black, subterete or compressed; asci clavate, .006 to .007 inch long, .0006 to .0007 broad; spores crowded, subfusiform, at first biconic and uniseptate, then triseptate or quadrinucleate, constricted in the middle, colorless, .0012 to .0016 inch long, .0003 to .0004 broad.

Decorticated wood of poplar, *Populus tremuloides*. Gansevoort. September.

Readily distinguished by the tawny, pulverulent tomentum of the perithecia.

LOPHIOTREMA PARASITICA, N. sp.

Perithecia crowded, subsuperficial, .014 to .02 inch broad, clothed with a minute subcervine pulverulent tomentum, becoming blackish-brown with age, the ostiola prominent, subterete or compressed, clothed like the perithecia; asci subclavate, .005 to .006 inch long, .0006 to .0007 broad; spores crowded, at first biconic, then triseptate, constricted in the middle, colorless, .0012 to .0016 inch long, .0003 broad.

On old *Hypoxylon Morsei*. Elizabethtown. September.

This and the preceding species appear to be peculiar by reason of the pulverulent tomentum of the perithecia. They would seem to constitute a distinct section of the genus.

(D.)

NOTES AND OBSERVATIONS

THALICTRUM PURPURASCENS, L.

A singular Thalictrum was found on the shore of Lake Champlain, near Port Henry. Its leaves were thin and delicate, quite small, and five to seven-lobed, resembling those of *Thalictrum dioicum*. Some had a general petiole, others had none. The flowers were almost dioecious, the anthers resembling those of *Thalictrum purpurascens*, though perhaps they were a little more slender and more strongly mucronate. The plants had the general aspect of *T. purpurascens*, except the leaves, which resembled more those of *T. dioicum*. *T. dioicum* in the same locality was past flowering, it being now the middle of June, and had developed its fruit to full size. Whether this plant is a hybrid between *T. dioicum* and *T. purpurascens*, or a variety of the latter, or a distinct species, is a question to be solved. Similar forms have been regarded by Professor Trelease as hybrids.

NASTURTIUM LACUSTRE, Gr.

Black creek, near Bergen.

ARABIS DRUMMONDII, Gr.

Port Henry. A form with spreading pods.

GEUM RIVALE, L.

A form with pale yellow or cream-colored flowers was collected in the Adirondack mountains. It is not rare in that locality.

RIBES CYNOSBATI, L.

A very lax form of this plant occurs at Cascadeville, in the Adirondack mountains. The branches are long and slender, and the flowers are much scattered and very long pedicelled. It is associated in this locality with *Ribes rotundifolium*, *R. lacustre* and *R. prostratum*. All were in flower at the same time. The last species occurs abundantly at Lower Ausable pond, where

nearly all the young fruit of a large patch was found infested by *Sphaerotheca Mors-uvae* Schw., which fungus is probably a mere variety of *Sphaerotheca pannosa* Lev.

ASTER SAGITTIFOLIUS, Willd.

This fine aster has not hitherto been represented in the herbarium. It is recorded in the New York State Flora as a rare plant n New York. Fine specimens were found near Piffard, Livingston county, and it occurs in great abundance along the railroad between that place and Rochester.

ASTER ACUMINATUS, Mx.

Glen Cove, Long Island. *J. A. Bisky.* A very noticeable station for this mountain-loving plant.

SOLIDAGO ULIGINOSA, Nutt.

Bergen swamp. A very slender form, with unusually narrow and entire leaves, and a rather short panicle, sometimes slightly recurved.

SYMPHORICARPUS RACEMOSUS, Mx.

Near Canajoharie. The variety *pauciflorus* in rocky places, near Port Henry.

POLYGONUM TENUE, Mx.

Summit of Cobble hill, near Elizabethtown.

SALIX CANDIDA, Willd.

Occurs sparingly near Guilderland Station. *H. C. Gordinier.*

ABIES ALBA, Mx.

Newcomb, Essex county. It also occurs in North Elba, but in all the localities observed by me the trees were growing in cleared land, and had evidently sprung up since the forests were cut.

ORCHIS SPECTABILIS, L.

A form with white flowers. Schaghticoke. *H. C. Gordinier.* Mr H. L. Griffis also sends a white-flowered form of the flowering wintergreen, *Polygala paucifolia*, from Binghamton.

CLINTONIA BOREALIS, Raf.

This plant grows almost everywhere in the Adirondack mountains, and in some places it is exceedingly thrifty and vigorous.

It is not uncommon to find plants with one or even two lateral umbels in addition to the terminal one. The number of flowers in the lateral umbels is generally less than the number in the terminal umbel of the same plant, and when there are three umbels the lowest one has the smallest number of flowers. They vary usually from three to six in the lateral umbels. In one specimen there were six flowers in the lateral and twelve in the terminal umbel. One plant had five large leaves.

SCLERIA VERTICILLATA, Muhl.

A small form with but three clusters of flowers is common in Bergen swamp.

CAREX ALOPECOIDEA, Tuckm.

This species is rare in the eastern part of the State. It occurs near Lansingburg. *E. C. Howe* and *H. C. Gordinier*.

CAREX FLAVA, L.

An extremely variable species, even in the same locality and apparently surrounded by the same circumstances and influences. At Hewitt's pond in the Adirondack mountains, specimens were collected which were but four or five inches high and which bore but a single small fertile spike each. Near these, others were found which were fifteen or sixteen inches high and bore five fertile spikes each. Another form, intermediate in size, had three fertile spikes, two approximate and a lower distinct one.

CAREX LONGIROSTRIS, Torr.

Rocky places. Keene. A rare species with us.

ALOPECURUS GENICULATUS, L.

Green Island. *H. C. Gordinier*. Lansingburg. *E. C. Howe*.

These specimens are nearly erect, not geniculate at the base. On the other hand, specimens of *Alopecurus pratensis*, a species described as erect, were collected by myself near Albany, in which the stems were decidedly geniculate at the base, thus exactly reversing this character as given in the descriptions.

AGROSTIS VULGARIS, With.

A form with very many of the flowers developed into leafy buds. Hewitts pond.

PANICUM CRUS-GALLI, L.

The form with dense panicles of awnless flowers is common in wet places about Warsaw, Wyoming county.

BOTRYCHIUM LANCEOLATUM, Angst.

Cascadeville, Adirondack mountains. June.

OMPHALIA UMBELLIFERA, L.

Not rare in the Adirondack mountains. Variety *abiegnus* grows on soft decayed wood of coniferous trees, and has a pale yellow pileus. Variety *alpinus* grows among mosses and on muck soil composed of decomposed vegetable matter. It usually occurs at high altitudes. It was plentiful in June on the summit of Mt. Marcy. In it the pileus and lamellae are bright yellow.

PHOLIOTA MYCENOIDES, Fr.

In thin woods at Conklingville a form was found having the pileus rugose.

LENZITES SEPIARIA, Fr.

A resupinate form, var. *dentifera*, occurs on spruce in the Adirondack mountains, in which form the lamellae anastomose, and are more or less toothed or lacerated, resembling an Irpex more than a Lenzites.

POLYPORUS VOLVATUS, Pk.

This singular species develops in May and June in the Adirondack mountains. When young it is slightly viscid. It is especially subject to the attacks of insects. In July most of the specimens will be found to be infested by them.

CREPIDOTUS HÆRENS, Pk.

Fine specimens of this rare species were found on ash and butternut near Sprakers. The pileus is sometimes slightly floccose-squamulose. The tough viscid pellicle is separable, and in drying the moisture disappears from the disk first, from the thin margin last.

HYDNUM GRAVEOLENS, Delast.

A singular Hydnum was found at Elizabethtown, in which the pileus was very uneven and everywhere coated with a whitish villosity or tomentum. It has the peculiar odor of *H. graveolens*, to which species we have referred it as variety *inæquale*.

PHLEBIA RADIATA, Fr.

Dead bark of wild bird cherry, *Prunus Pennsylvanica*. Conklingville. September. A thin cream-colored form corresponding nearly to variety *pallida Fr*. It sometimes forms extensive patches by the confluence of many individuals.

ODONTIA FIMBRIATA, Pers.

Decaying wood of poplar. Conklingville. September. A form with the subiculum thicker than usual and finely rimose. Variety *rimosa*.

PENIOPHORA NEGLECTA, Pk.

A wholly resupinate form occurs on red maple. *Acer rubrum*. Bergen.

CORTICIUM MARTIANUM, B. & C.

When well developed this is a highly colored and very showy species. At first a small orbicular tuft of strigose radiating hairs appears. The center of the tuft soon assume a reddish tint, which again changes to bright-red or scarlet and becomes waxy. The hymenium is now covered with irregular rugae or folds giving the plant the appearance of some species of Phlebia. With advancing age the hymenium loses its brilliancy and becomes tinged with brownish, grayish or olivaceous tints, but the margin retains for a longer time its bright-red color, which fades to gray on the extreme fimbriate edge. The mycelium is yellowish. Metuloids have been seen in some specimens, but they are rare.

SPHÆROPSIS MALORUM, Pk.

This has occurred on leaves of apple trees, but in this case with perithecia rather smaller than in the type.

MARSONIA JUGLANDIS, Sacc.

The species is quite variable, being both hypophyllous and epiphyllous, and occurring on small or large spots and with few or many nuclei.

SEPTOCYLINDRIUM RANUNCULI, Pk.

This has occurred on radical leaves of *Ranunculus abortivus*. Helderberg mountains. May.

RAMULARIA PLANTAGINIS, E. & M.

Variety *nigromaculans* Pk. Spots with a small grayish center and a broad blackish or blackish-brown margin. The fungus occurs on this blackish margin. Menands. October.

PERONOSPORA GANGLIFORMIS, De By.

Living leaves of *Sonchus asper*. Warsaw.

PEZICULA ACERICOLA, Pk.

Variety *gregaria* Pk. Receptacles small, gregarious. Bark of red maple, *Acer rubrum*. Karner. September.

RHYTISMA SALICINUM, Fr.

Fallen leaves of Salix Cutleri. Mt. Marcy. June. Fertile specimens.

VII

REPORT OF THE STATE ENTOMOLOGIST

General. The Entomologist reports that the season of 1918 resented many features in common with the abnormal spring and ummer of 1917. The rainfall in the western part of the State was ot so great as last year and the injury then so generally attributed) the seed corn maggot was much less prevalent, and limited very rgely to the wetter ground. The developments of both last year id this have shown that the seed corn maggot problem is largely a uestion of methods, the depth of planting and drainage being the ore important factors and the insect injury largely a consequence unfavorable conditions.

The apple tent caterpillar was notable for its absence in most ctions of the State, particularly in portions of Dutchess county. he late leaf feeders, such as the red-humped apple worm and the ellow-necked apple worm were, as last year, exceptionally abundant, id there has been even more severe damage in Rensselaer and Col- nbia counties, in particular. The fall webworm, the hickory tussock oth caterpillar and some related species were also uncommonly umerous and destructive.

Fruit tree insects. Reports received by the Entomologist from eas infested by the recently established apple and thorn skeletonizer dicate a moderate abundance of the insect with some extension of ie infested territory. It is now known to occur from Yonkers orth to Yorktown Heights and it appears to be somewhat generally istributed in Nyack.

Codling moth. Field studies of the codling moth were continued y the Entomologist in cooperation with the bureau of horticulture the State Department of Farms and Markets. Evening tempera- ure records were kept by Mr George W. Mead, living 3 miles west Barker and about 2 miles from Lake Ontario, and Mr E. E. Crosby, siding 4 miles southeast of Lockport and located on the Erie plain out 14 miles from the lake. Interesting variations between these wo localities were found to exist and as evening temperatures greatly fluence the deposition of codling moth eggs, these data have a ractical bearing and serve to explain some apparent inconsistencies the abundance of the pest in various orchards. The observations deposition of eggs in different parts of Erie county by Mr L. F.

Strickland, inspector of the Department of Farms and Markets, show an interesting correlation between high evening temperatures and oviposition by this very injurious insect.

Field tests were also conducted to determine the possibility of destroying the moths before they laid their eggs by spraying the trees thoroughly with a nicotine preparation, other insecticides being simply incidental to the main purpose. Work of this kind was conducted on the farm of Mr L. L. Morrell, Kinderhook, and that of Mr R. E. Heard, Lockport. The spraying on this latter was under the supervision of Mr Strickland and a canvass of the results shows a decided improvement following the application. The data amply warrant the continuation of work along this line.

The series of experiments to determine the relative efficiency of the several sprays for control of codling moth have been continued in the western part of the State and the data in relation thereto are given in a general discussion of the codling moth work.

Observations relating to the following insects are based on field work and reports by the Entomologist and his correspondents.

Apple maggot. It was not possible to continue the field work with this insect, though it happens that the orchard sprayed with poison late the preceding season was gratifyingly free from injury last summer. There was no spraying the past season and the fruit was very severely damaged. This alone suggests that a late application of poison at the time the flies are issuing is the most promising method of controlling the pest, particularly since similar results have been obtained by other workers.

White-marked tussock moth. The past season has been noteworthy because of the unusual abundance of the caterpillars in orchards and the consequent general and rather serious damage to the fruit. It was this insect rather than the leaf roller which injured most of the apples in many localities.

Red bugs. Injuries by red bugs are becoming increasingly abundant here and there in the State. Fruit growers suffer considerable losses from these pests and frequently secure only indifferent results in control work due to variations in the time of hatching of the bugs and the further fact that spraying, in order to give the best results, must be done while the bugs are small and their work relatively inconspicuous.

San José scale. This serious pest of earlier years has attracted comparatively little attention the past two seasons. Spraying with lime-sulphur wash at winter strength has uniformly resulted in

satisfactory control and in not a few localities there has been but little breeding even in unsprayed orchards. The wet, cold weather of early summer has probably had an important influence on the development of this insect, and largely checked its breeding, though parasites doubtlessly have rendered material assistance.

Pear thrips. This minute and destructive pest is sporadically abundant here and there in the pear-growing sections, specially in the Hudson valley, and despite the watchfulness of fruit growers there is likely to be considerable loss before the seriousness of the infestation is appreciated or the need of immediate action realized.

Pear psylla. There have been some reports of injury by pear psylla though in many localities the insect has been only moderately abundant and in not a few almost absent. The cool weather and heavy rains have had a marked influence in preventing the pest from multiplying greatly.

Grass and grain pests. The cool weather and abundant rains of last spring, as in 1917, were unfavorable to the development of sufficient grasshoppers to cause serious damage and in most sections these insects were not unusually abundant though toward the end of the season they were somewhat numerous in restricted localities.

The white grub injury rendered probable by the abundance of May and June beetles in 1917, failed to develop in most localities. There was material injury in restricted areas though this was hardly comparable to that of 1915. Warning notices outlining probabilities were issued in early spring and it is very probable that in many localities the comparative freedom from damage was due to farmers taking precautions and not planting crops liable to injury, such as corn and potatoes on land where conditions favored an abundance of white grubs.

Wheat midge was prevalent in the rye fields of the eastern part of the State and caused somewhat more damage than in 1917. The wheat fields of the western section were also generally infested by this insect. A survey of the situation by the Entomologist covering Erie, Genesee, Niagara and Orleans counties disclosed a general prevalence of the insect practically without reference to time of sowing, depth of plowing or previous treatment, though it was noteworthy that, generally speaking, the more vigorous fields showed less of the pest. The bearded wheats are usually less infested. The results of these studies are summarized in the body of the report.

Grass lands, specially pastures and corn fields, were seriously injured in Broome county localities by grass webworms and the

associated bronze-colored cutworm and also the greasy cutworm. There were complaints of serious injury to corn by webworms and damage by the lined corn borer was also reported.

Investigation by the Entomologist of the European corn borer, shows it to be very destructive in eastern Massachusetts. The occurrence of the pest in New York State would probably mean great losses unless there was effective control. Potentially it is a serious enemy of corn and other important crops. It is extremely desirable to prevent its spread. The history of other pests in this country suggests that actual extermination, though costly, would be true economy. There should be at least a determined effort to accomplish this through federal and state agencies.

Field crops. There was some injury to beans by the seed corn maggot. This was much less than in 1917 in spite of the fact that there was considerable wet weather. The comparative immunity was due largely to modifications in methods, care being taken not to put beans on wet land and if this was necessary, shallow rather than deep planting seemed to be the rule.

Potato aphis appeared toward the end of June on Long Island and later developed in the Hudson valley and was reported from the central part of the State. The history of the attack was very similar to that of 1917. The damage was markedly less, owing to the farmers more generally appreciating the status of the pest and being ready to adopt control measures whenever conditions justified them.

Black flea-beetles were unusually abundant and injurious on Long Island, in the Hudson valley and in some other sections of the State, the damage being limited mostly to potato and tomato plants recently transplanted. The probabilities are that poor culture the preceding year, due presumably to scarcity of labor, was a factor in producing conditions favorable to injury by this pest. Similar conditions, possibly more accentuated, may be expected another season.

Forest tree pests. There has been comparatively little damage by insects to forest trees though there was some stripping of woodlands in the Catskills by caterpillars of the snow-white linden moth. The antlered maple caterpillar defoliated extensive areas in the nearby Berkshires and was reported from one New York locality. The fall, as in 1917, was characterized by an unusual abundance of hickory tussock moth caterpillars and associated species, though the damage does not appear to have been so extensive.

Insects and health. The necessity of controlling flies and other insects frequenting human habitations has been greatly emphasized

by the extensive mobilization of troops. This was anticipated by the Entomologist in the preparation of *Household and Camp Insects*, Museum Bulletin 194, which appeared in February 1917. The publication was widely distributed among military officers in the army as well as to those specially interested in work of this kind throughout the country. There has been a constant demand for the bulletin throughout the season. The Entomologist has given considerable attention to various phases of this problem.

The importance of insect control in camp and field is apparent when it is recalled that diseases have been responsible for more deaths in armies during war times than are caused by wounds and that such infections as typhus, cholera, malaria of various types, trench fever and typhoid fever may be carried by insects, and some of the more important of these infections are disseminated only by such agents. It therefore follows that the application of precise knowledge regarding the habits of insects to the extremely varied conditions encountered by an army in the field and particularly an appreciation of the benefits resulting from the avoidance or amelioration of conditions favorable to the reproduction of dangerous insects, means an enormous advantage to the units in a position to utilize such knowledge.

The broader phases of insect control and sanitation were discussed by the Entomologists at the Pittsburgh meeting of the American Association of Economic Entomologists and as an outcome a special committee, of which the Entomologist was a member, was appointed for the purpose of promoting the better utilization of the entomological talent of the country in army sanitation. There were several conferences with representatives of the Surgeon General and a number of entomologists have been demonstrating the utility of their calling as active members of sanitary corps. Furthermore, the Entomologist, upon the invitation of the camp surgeon, made an examination of conditions at Camp Upton with special reference to the complex mosquito problem of that section.

Another very important phase deserves consideration at this time, namely, the desirability of adopting every reasonable precaution to prevent epidemics after the establishment of peace. Various infections have been widely distributed as a result of the wholesale movement and dissemination of troops and with entire nations suffering from malnutrition, conditions will be almost ideal for extensive epidemics when warm weather permits insects to become active carriers of disease. The peril is greatest in portions of Europe, though sections to which troops return will by no means be free from

danger. Doctor Prinzing, in his monograph on " Epidemics Resulting from Wars " states that, " Until comparatively recent times the most serious human cost of war has not been losses in the field, nor even the losses from disease in the armies, but the losses from epidemics disseminated among the civil population. It was the war epidemics and their sequelae, rather than direct military losses that accounted for the deep prostration of Germany after the Thirty Years' War. Such epidemics were also the gravest consequence of the Napoleonic Wars." Wasted resources and reduced man power in certain European countries mean a relaxation of sanitary precautions and with the renewed activities of insects another season there will be almost unexampled opportunities for the spread of disease unless precautions are adopted and rigidly enforced at the very outset.

Special entomological service. The plan was to promote the production of larger and better crops and was a development from and continuation of the insect pest survey and information service conducted by the Entomologist during the summer of 1917. It was emergency war work. A series of weekly reports or digests were issued throughout the active part of the season, the first appearing May 23d and the last August 1st. These were distributed to farm bureau agents throughout the State and to a number of specially interested persons, particularly those in position to influence the adoption of better measures for the control of insect pests. This was supplemented by correspondence directing the attention of observers to features of special importance. The service was possible only through the cooperation of the farm bureau agents and a number of observers in various parts of the State, the latter mostly earlier correspondents of the office. In addition to the weekly reports mentioned above, special circulars were issued warning of probable injury by grass webworm, potato aphis, summer leaf feeders and the wheat midge and recording the most recent developments.

The main purpose of the undertaking was to secure early and accurate reports of insect activities from all over the State, to summarize the information thus obtained, distribute it promptly, and thus effect material reduction in the serious losses annually inflicted by these pests. Particular emphasis was laid upon the initial signs of injury in order to promote control before much damage had been caused. The more important crops received first attention, specially the insect enemies of potatoes, such fruits as apples, pears, peaches and cherries, cereal and forage crops and truck and garden crops.

It is impossible, from the nature of the case, to give exact figures as to the value of the service. The mere fact that a close watch was

ept for such injury is worth much in times when every effort should e made to increase production. An estimate made in 1913 placed ne approximate damage in this State to all farm crops at $20,000,000 nnually. The figures should be considerably higher now. Further- nore there is need of discouraging unwise or misdirected efforts gainst insects of little importance or the use of materials or methods f doubtful efficiency. The Entomologist has constantly kept these roblems in mind and in working through farm bureau agents has een able to do much in standardizing practices and increasing roduction.

The Entomologist has also served as collaborator with the Emer- ency Entomological Service of the United States Bureau of Entomol- gy, thus assisting in improving conditions in the country as a whole nd at the same time bringing the state work into closer touch with nat of Nation, to the mutual advantage of both.

Gall insects. The "Key to American Insect Galls" has been arried through the press. It is the only comprehensive tabulation f these interesting deformities and since it deals primarily with the nore obvious swellings or plant malformations rather than with ne minute and highly complex gall makers themselves, it will greatly acilitate the study of the interrelations between plants and insects. here was also brought together and tabulated in this bulletin data hich are of value in interpreting biological processes and are not ithout their economic or practical bearing, since a number of species omprised in this large group are pests of prime importance, notably he Hessian fly and the wheat midge, the latter being much more estructive in earlier years than at the present time.

Some attention has been given to gall midges and a number of nteresting forms, including several new genera, have been described.

Lectures. The Entomologist has delivered a number of lectures n insects, mostly economic species, before various agricultural and orticultural gatherings, some of these being in cooperation with armers' institute or county farm bureau agents. Several lectures ave also been given under the auspices of local welfare associations.

Publications. Brief popular accounts of the more destructive nsects have been prepared as heretofore and widely circulated through he county farm bureaus and the local papers.

Owing to delay in printing, the report for 1916 did not appear until he current year and is the only Museum bulletin on entomology ssued in the period covered by this report. A paper on "Insects nd Camp Sanitation" was prepared for the *Journal of Economic*

Entomology. A general popular discussion entitled "Gall Insects and their Relations to Plants" appeared in the June issue of the *Scientific Monthly.* A popular summary of losses caused by insects and the possibilities in control measures was published in *State Service* under the title "Insects Destroy Millions in Property." The need of continuing entomological investigations even under war conditions was presented under the title "Entomological Research and Utility" in the *Scientific Monthly.* There were also several technical papers describing gall midges. A list of the publications of the Entomologist is given in his report.

Collections. Very desirable additions to the state entomological collections have been made through the year, some of the best material being reared in connection with studies of insect outbreaks or as a result of requests for information concerning previously unknown forms. Special attention has been paid to the acquisition and preservation of immature stages, since these are very difficult to secure. A noteworthy donation of this character was that from Instructor C. P. Alexander of the University of Kansas, whose work on the Tipulidae is well known. It comprises a series of larvae and pupae of representative Crane flies belonging to 11 genera and 16 species. A list of these is given under accessions to the collections. A recent communication from Mr Alexander states that we have one of the foremost collections of Crane flies in America — largely due to the efforts of Mr Young. A list of the accessions appears in the Entomologist's report.

Unusual demands for the identification of insects and information in regard to methods of control, partly a result of war conditions, has restricted the amount of time which could be given to the identification and arrangement of the collections. This latter is necessary, otherwise collections may be simply miscellaneous aggregations of unknown material of comparatively little service to any one.

Mr D. B. Young, in addition to numerous identifications for correspondents, and other routine work, has made material progress in arranging and classifying the important parasitic flies belonging to the Tachinidae and is now devoting much time to the difficult Anthomyiidae, among which latter are found such pests as the onion maggot and the cabbage maggot. He was also exceptionally fortunate in collecting at Wells a large series of Amphicoma vulpina Hentz, an extremely rare Scaraebaeid hitherto represented in the state collections by only one or two specimens without a recorded locality.

The maintenance and development of an adequate representation the insect life of the State means an enormous amount of work and ith the passing of the present war stringency more adequate provi- on should be made for this line of activity. There are more than ,000 species of insects in the State, each represented by at least ur stages and not a few presenting marked differences between the arious molts or instars of the larva. This gives an idea of the normous number of forms falling within the province of the Ento- ologist. A thoroughly representative state collection should con- ain specimens of all and in the case of many variable species, specimens f both typical and aberrant forms. Such a collection possesses not nly scientific value because of the immense amount of material ssembled and the lines of development illustrated, but is of great ractical service in the speedy identification of any one of the thou- ands of insects of the State which without warning may become ddenly abundant and destructive. It is well known that satisfac- ory control measures can not be advised without at least some nowledge of the habits of the insect and the more complete this is he more reliable the recommendations.

The development of collections requires adequate space. The onstant increments of recent years have filled the boxes or trays to uch an extent that there is urgent need of more space for this material. The wooden cases containing the insect collections should be replaced y steel cabinets and more provided to accommodate the additional oxes and trays required. Biological material, specimens difficult o secure and not easily preserved in a satisfactory manner should eceive special attention. There are now in the entomological collections a long series of types of species and genera. The possession f these uniques involves a responsibility to future generations and very precaution should be adopted to maintain the integrity of the collections if the entomological branch of the Museum is to discharge ts full duty to both State and Nation.

Nursery inspection. The nursery inspection work of the State Department of Farms and Markets has resulted, as in former years, n a number of specimens representing various stages of insect develop- ment, some in very poor condition, being submitted to the Entomolo- gist for identification. As such material may originate in a foreign country, the determinations of this character are difficult and require for their successful prosecution a large collection and an excellent ibrary of both domestic and foreign works. The correct identifica- ion of such material is important since the disposal of an entire

shipment of nursery stock may be affected by the character of the infestation.

The entomological work has been materially aided as in past years, by the identification of a number of species, through the courtesy of Dr L. O. Howard, chief of the bureau of entomology, United States Department of Agriculture, and his associates. There has been very effective cooperation with the State Department of Farms and Markets and its agents, the county farm bureaus, the state experiment stations and other public welfare organizations. A number of correspondents have donated valuable specimens and many have aided materially by transmitting local data respecting various insects or assisted in other ways.

VIII

REPORT OF THE ZOOLOGIST

The report of the Zoologist covers the fiscal years of 1917–18. ield investigation continued the work of the previous year; particu- rly, the collection of spiders from localities in the State hitherto eglected. Valcour island, Lake Champlain and the region near the utheast end of Lake George yielded many species new to the State nd added much to our knowledge of the distribution of other species. articular attention was given to the study of the genus Dolomedes view of a revision of that group. A week in October 1917 was ent in the vicinity of Newcomb, where N. T. Clarke and the ologist collected material for a habitat group of beavers. A large male beaver, portions of a dam and "house" and numerous amples of "cuttings" were secured, which, with the material ready in the Museum, are being assembled in a realistic manner in he new group.

The group when finished will occupy a case 16 by 11 feet, open on wo sides and exhibiting in part a beaver "flow," part of a dam and ie animals in positions suggestive of their activities. A painted micircular background 25 feet long will continue the illusion of the flow" into the distance and give a typical Adirondack setting.

Several new groups added during 1917 (woodchuck, otter and icker) were mentioned in the report of the Director for that year. n 1918 a group of timber wolves, depicting an early winter hunting ene, was installed by Mr Henri Marchand from plans worked out y the Zoologist.

During the absence of the Zoologist in naval service in 1918, cientific investigation in the division of zoology was necessarily artailed; nevertheless a considerable amount of technical work was arried on by N. T. Clarke in the preparation and installation of an xtensive series of especially designed plaster mounts for the Benja- nin W. Arnold collection of birds' eggs.

The services of Mr Silas C. Wheat of Brooklyn, an accomplished onchologist, were secured for a period of several months in 1918. Ir Wheat devoted himself to the study and arrangement of part of he Museum's valuable collection of mollusks, most of which have

been kept in storage because of lack of exhibiting space. The entire collection of mollusks has recently been assembled in new storage cases and made available for study. Much work still remains to be done, however, before the collection can be considered properly cared for.

The removal of the old style cases from the corridors leading to zoology hall being necessitated by the installation of the Arnold collection, new wall cases were constructed for the series of mounted fishes and the entire exhibit rearranged in zoology hall proper. The new arrangement admits of better lighting and distribution of specimens and permits indefinite expansion through the simple expedient of continuing the cases around the wall.

Under the direction of C. A. Hartnagel a set of panels was constructed which appropriately frame the series of seventy original drawings of birds by Ernest Thompson Seton. Placed above the Arnold collection of birds' eggs in the corridor leading to zoology hall they contribute considerable interest aside from their decorative value.

The most important additions made during the period covered by this report were the collections of birds' eggs presented to the State Museum by Benjamin W. Arnold, of which a complete catalog is in preparation. Through the courtesy of the United States Bureau of Fisheries, the State Museum has received from the Fairport, Iowa, Biological Station an exhibit designed to show the manufacture of pearl buttons from the shells of fresh-water bivalve mollusks.

For the past several years Prof. C. R. Crosby of Cornell University and the Zoologist have given their attention as time permitted, to the study of New York spiders. As a result considerable progress in the preparation of a memoir on this group may be reported. As now planned the work will embrace descriptions of all the species known to the State, particular attention being given to the structure of the male palpi and epigyna of the females. Keys to families, genera and species will, it is hoped, increase the value of the work to students and stimulate investigation. A series of drawings in color of many of the species will aid in the determination of them and illustrate some of the biological phenomena of variation, mimicry, and protective coloration (see colored plate). Systematic field work has been carried on in many parts of the State and extensive collections brought together. It will be necessary to continue this kind of work for some time, however, to cover the State thoroughly and make the list of species a representative one.

Araneus trifolium (Hentz)
Female (x2)

Araneus cornutus Clerck
Female (x2)

Araneus stellatus (Walckenaer)
Female (x2)

Araneus trifolium (Hentz)
Female (x2)

Araneus marmoreus Clerck
Female (x2)

A study of the fossil mammals of the State has been carried on with A. Hartnagel with the view of bringing together from the scattered erature of the subject an account of this interesting fauna. Material d information is also being accumulated bearing on the former and esent distribution of mammals, reptiles and batrachians pending a nplete and exhaustive survey of the State biologically:

The study of the myriapods of New York, which was intrusted ne time ago to Mr Roy W. Miner of the American Museum of atural History, has been interrupted by duties resulting from war ivities but is now reported as in progress and it is hoped that this vestigation of a group of New York species not heretofore closely udied may be soon presented to the public.

The monograph of the New York land and fresh-water mollusca, hich has been frequently referred to in previous annual reports as course of preparation by Dr H. A. Pilsbry, is now close to comple-n, the drawings in color and in black and white having been made th great care by Helen Winchester. It is believed that this memoir, en printed, will reawaken the interest in the New York molluscan ana which formerly was a subject of widespread concern to our izens.

ACCESSIONS TO ZOOLOGY DEPARTMENT IN 1917

Donation

Mollusca

Bureau of Fisheries, Fairport, Iowa, Biological Station

Collection of fresh-water shells and implements used in the manufacture of pearl buttons.

Yellow sand-shell, Lampsilis anondontoides.....Mississippi river, Fairport, Iowa

Slough sand-shell, Lampsilis fallaciosa....White river, Arkansas

Higgin's eye, Lampsilis higginsii.....Mississippi river, Fairport, Iowa

Mucket, Lampsilis ligamentina.....Mississippi river, Fairport, Iowa

Southern mucket, Lampsilis ligamentina gibba.....Cumberland river, Burnside, Ky.

Black sand-shell, Lampsilis recta.....Mississippi river, Fairport, Iowa

Pocketbook, Lampsilis ventricosa.....Mississippi river, Fairport, Iowa

Three-ridge, Quadrula undulata.....Baum's Ridge, Kankakee river

Niggerhead, Quadrula ebenus.....Mississippi river, Fairport, Iowa

Pimple-back, Quadrula pustulosa.....Mississippi river, Fairport, Iowa

Washboard, Quadrula heros.....Mississippi river, Fairport, Iowa

Maple-leaf, Quadrula lachrymosa.....Mississippi river, Fairport, Iowa

Ohio River pig-toe, Quadrula obliqua.....Ohio river

Pig-toe, Quadrula undata.....Mississippi river, Fairport, Iowa

Blue-point, Quadrula plicata.....Mississippi river, Fairport, Iowa

Monkey-face, Quadrula metanevra.....Mississippi river, Fairport, Iowa

Butterfly, Plagiola securis.....Mississippi river, Fairport, Iowa

Bullhead, Poeurobema aesopus.....Mississippi river, Fairport, Iowa

Elephant's ear, Unio crassidens.....Mississippi river, Fairport, Iowa

Lady-finger, Unio gibbosus.....Mississippi river, Fairport, Iowa
Missouri niggerhead, Abovaria ellipsis.....Mississippi river, Fairport, Iowa
Buckhorn, Tritogonia tuberculata.....Mississippi river, Fairport, Iowa
White heel-splitter, Symphynota complanata.....Mississippi river, Fairport, Iowa
1-2 dozen 18-line button saws
Valves of shells from which blanks have been cut
Blanks: 16, 20, and 24-line cut from valves; rough, unfinished and of varying thicknesses
Blanks, 24-line ground or backed to proper thickness
Blanks, 24-line, shaped on one face
Blanks, 24-line, with groove cut on one side i. e. cat's eye or fish eye
Button drills for making holes
Blanks, 24-line, drilled
24-line finished buttons
Smoked buttons; two shades of smoking
Novelties made from pieces of polished shells

, John, New Haven, Conn.
Six species of shells and two species of coral from Florida east coast

r, Dr Smith, Camden
A large collection of fresh-water mollusks from various localities in New York

ulloch, Walter S., Albany
Seven specimens of tropical shells from the Bahamas

Birds and Eggs

ld, Benjamin W., Albany
e Benjamin W. Arnold collection of North American, South American, European, Falkland island and African birds' eggs numbering about 1800 sets, presented to the New York State Museum February 1, 1917. Complete catalog in preparation.

, Dr T. L., Albany

Mounted specimens of birds of the following species:	No. spec.
Red-throated loon, Gavia stellata (Pontoppidan) Adult male	1
Mallard, Anas platyrhynchos Linn. Adult male	1
Flamingo, Phoenicopterus ruber Linn. Adult male	1
Roseate spoonbill, Ajaia ajaja (Linn) Adult male	1
Scarlet ibis, Guara rubra (Linn) Adult male and female	2
Egret, Herodias egretta (Gmelin) Adult female	1
Osprey, Pandion haliaetus carolinensis (Gmelin) Adult male	1
Barn owl, Aluco pratincola (Bonaparte) Adult male	1
Great horned owl, Bubo virginianus (Gmelin) Adult female	1

Purple martin, Prognesubis (Linn) Immature.....
Cliff swallow, Petrochelidon lunifrons (Say) Adult male...
Barn swallow, Hirundo erythrogastra Boddaert Adult male
Tree swallow, Iridoprocne bicolor (Vieillot) Adult male....
Bank swallow, Riparia riparia (Linn) Adult male.....

Birds' Eggs

Numb

Ostrich.....
Rhea.....
Cassowary.....

Introduced Birds

Amherst pheasant, Chrysolophus amherstiae Adult male.
Fire-back pheasant, Lophura nobilis Adult male.....
Gray jungle fowl, Gallus sonnerati Temm. Adult male.....

Boyd, Harold, Rensselaer
Green heron, Butorides virescens virescens (Linn) Adult female.....

Haner, Robert B., Albany
Scarlet tanager, Piranga erythromelas Vieillot Male.....

Seymour, May, Lake Placid
Cedar waxwing, Bombycilla cedrorum Vieillot Female....

Slattery, Hugh, Albany
Pied-billed grebe, Podilymbus podiceps (Linn) Male.....

Ritchey, R. H., Albany
Song sparrow, Melospiza melodia melodia (Wilson)
Nests and eggs.....

Mesick, Mrs Sarah, Albany
Baltimore oriole, Icterus galbula (Linn) Adult male.....
Scarlet tanager, Piranga erythromelas Vieillot Adult male....
Cedar waxwing, Bombycilla cedrorum Vieillot Adult male....
Myrtle warbler, Dendroica coronata (Linn) Adult male.....
Bay-breasted warbler, Dendroica castanea (Wilson) Adult male.....
Blackburnian warbler, Dendroica fusca (Muller) Male.....
Maryland yellow-throat, Geothlypis trichas trichas (Linn) Male.....

Collection

Birds

Clarke, N. T. and Bishop, S. C., Albany
Flicker, Colaptes auratus auratus (Linn) Nest and 5 young

Donation

Mammals

ws, Edward, South Bristol
oyote, Canis latrans Say Adult male..... 1
t specimen of coyote recorded from New York State. Shot by Mr ws on Gannet Hill, South Bristol, N. Y., Dec. 14, 1916 and presented by o the State Museum.

Dr T. L., Albany
ray fox, Urocyon cinereoargenteus cinereoargenteus (Schreber) Skull..... 1
rs, Oscar, Nassau
Muskrat, Ondatra zibethica (Linn) Skull..... 1

Collection

Mammals

ws, Edward, South Bristol, and **Bishop, S. C.,** Albany
Northeastern gray squirrel, Sciurus carolinensis leucotis (Gapper) Male..... 1
s, N. T. and **Bishop, S. C.,** Albany
Beaver, Castor canadensis Kuhl., Newcomb river, Essex county, N. Y. Female..... 1
p, S. C., Albany
Large blarina, Blarina brevicauda (Say) Lake George, N. Y.... 1

Donation

Fishes

Dr T. L., Albany
Mounted fishes.....13
rvation Commission, Albany
White fish, Coregonus quadrilateralis Rich..... 1

Collection

Fishes

Long-eared sunfish, Lepomis auritus (Linn)..... 1
Sunfish, Eupomis gibbosus (Linn)..... 1
Taken in Lake George, N. Y.; S. C. Bishop, Coll.

Donation

Reptiles

r, John, Albany
Spotted turtle, Clemmys guttata (Schneider) Male..... 1
, Mrs Clara F., South Nyack-on-Hudson
Black snake, Coluber constrictor constrictor (Linn)... 1
Copperhead, Agkistrodon mokasen Beauvois..... 1

Donor unknown. Specimens from McAllen, Texas
Horned toad, Phrynosoma cornutum (Harlan).....
Lizard sp.....

Cord, Dr Lester F., Albany
Alligator, Alligator mississipiensis (Daudin) Florida.....

Lyon, Dr T. L., Albany
Alligator, Alligator mississipiensis (Daudin) Florida.....

Purchase

Reptiles and Amphibians

Ward's Natural Science Establishment, Rochester
Plaster casts of turtles and salamanders
Diamond-back terrapin, Malaclemys centrata (Latreille).....
Wood-turtle, Clemmys insculpta (Le Conte).....
Musk-turtle, Kinosternon odoratum (Latreille).....
Slimy salamander, Plethodon glutinosus (Green).....

Collection

Reptiles and Amphibians

Bishop, S. C., Albany
Specimens collected at Lake George, N. Y., July and August, 1917
Smooth green snake, Liopeltis vernalis (Harlan).....
Garter-snake, Thamnopsis sirtalis sirtalis (Linn).....
Green frog, Rana clamitans Lat.....
Pickerel frog, Rana palustris Le Conte.....
Peeper, Hyla crucifer Wied.....
Pour-toed salamander, Hemidactylium scutatum (Schlegel)..
Newcomb, N. Y.
Dusky salamander, Plethodon cinereus (Green).....

Donation

Invertebrates

Clarke, Dr John M., Albany
Star-fish, Henricia sanguinolenta (Muller).....

Gates, Mrs Clara F., South Nyack-on-Hudson
Squid, Loligo pealii (Les).....

Araneida

Bullion, John, Hudson Falls
Araneus stellatus (Walckenaer) Adult female.....

Vitting, A., Albany
Salticus scenicus (Clerck) Adult female.....

Young, D. B., Albany
Dictyna sublata (Hentz) Immature female.....

tman, Miss F. T., Albany
Clubiona emertoni (Petrunkevitch) From Colorado..... 1
ke, Mrs John M., Albany
Araneus trifolium candicans (McCook) Adult female..... 1
sing, H. A., Menands
Argiope aurantia Lucas Adult female..... 1

Collection

Araneida

iop, S. C., Albany
Araneus arabescus (Walckenaer) Adult female..... 1
Araneus marmoreus Clerck. Adult female..... 1
Araneus pratensis (Hentz) Adult female..... 1

rom Rensselaer, N. Y.
Pardosa xerampelina (Keyserling) Males and females..... 3
Araneus marmoreus Clerck. Males and females..... 4
Araneus trifolium (Hentz) Females and egg cases..... 4
Argiope aurantia Lucas Females and egg cases..... 3
Argiope trifasciata (Forskal) Females..... 2

rom Lake George, N. Y. Number of vials
Theridion murarium Emerton..... 2
Dendryphantes mccooki (Peckham)..... 1
Amaurobius bennetti (Blackwall)..... 1
Araneus patagiatus Clerck..... 1
Araneus arabescus (Walckenaer)..... 2
Tetragnatha elongata Walckenaer..... 1
Habrocestum pulex (Hentz)..... 1
Xysticus elegans Keyserling..... 2
Drassodes neglectus (Keyserling)..... 1
Gnaphosa gigantea Keyserling..... 1
Cesonia bilineata (Hentz)..... 1
Agelena naevia Walckenaer..... 1
Dolomedes fontanus Emerton..... 7
Clubiona obesa Hentz..... 1
Lycosa gulosa Walckenaer..... 1
Lycosa frondicola Emerton..... 3
Lycosa helluo Walckenaer..... 1
Lycosa aspersa Hentz..... 1

rom Valcour island, Lake Champlain. List of species
Hyptiotes cavatus (Hentz)
Amaurobius bennetti (Blackwall)
Dictyna volucripes Keyserling
Scotolathys pallida (Marx)
Cesonia bilineata (Hentz)
Dipoena nigra (Emerton)
Euryopis funebris (Hentz)

Steatoda borealis (Hentz)
Theridion differens Emerton
Theridion frondeum Hentz
Theridion spirale Emerton
Theridion tepidariorum C. Koch
Ceratinella brunnea Emerton
Ceraticelus fissiceps (Cambridge)
Ceraticelus laetabilis (Cambridge)
Grammonota pictilis (Cambridge)
Linyphia marginata C. Koch
Linyphia phrygiana C. Koch
Araneus arabescus (Walckenaer)
Araneus benjaminus (Walckenaer)
Araneus cornutus Clerck
Araneus patagiatus Clerck
Araneus trifolium (Hentz)
Argiope aurantia Lucas
Argiope trifasciata (Forskal)
Cyclosa conica (Pallas)
Mangora gibberosa (Hentz)
Meta menardi (Latreille)
Tetragnatha elongata Walckenaer
Tetragnatha extensa (Linn)
Tetragnatha laboriosa Hentz
Misumena vatia (Clerck)
Philodromus exilis Banks
Philodromus pernix Blackwall
Thanatus coloradensis Keyserling
Tibellus oblongus (Walckenaer)
Xysticus versicolor (Keyserling)
Castaneira descripta (Hentz)
Agelena naevia Walckenaer
Cicurina brevis (Emerton)
Cicurnia pallida Keyserling
Phrurolithus sp.
Coelotes calcaratus Keyserling
Coelotes montanus Emerton
Coras medicinalis (Hentz)
Dolomedes fontanus Emerton
Dolomedes tenebrosus Hentz
Lycosa frondicola Emerton
Lycosa pratensis Emerton
Pardosa lapidicina Emerton
Dendryphantes marginatus (Walckenaer)
Evarcha hoyi (Peckham)
Habrocestum pulex (Hentz)
Neon nellii Peckham

ACCESSIONS TO ZOOLOGY DEPARTMENT DURING 1918

Donation

Mollusca

at, Silas C., Brooklyn — Number of specimens

Anodonta implicata Say; Park Lake, Brooklyn, N. Y. 1
Littorina littorea Linn; Jamaica Bay 6
Alectrion trivittata Say; Bayville 6
Eupleura caudata Say; Bayville 6
Hemimactra daytoni Wheat; Raritan Bay off Staten Island 6

Reptiles and Amphibians

l's Natural Science Establishment, Rochester

Map-turtle, Graptemys geographica (Le Sueur) from Irondequoit bay, N. Y. 1

, A. W., Albany

Tree toad, sp. From Havana, Cuba. Found in a bunch of bananas, July 1918.

Birds

p, Frederick J., Auburn

Black vulture, Catharista urubu (Vieillot) Adult male 1
Captured in the town of Victory, Cayuga county, April 11, 1911

or unknown

Barred owl, Strix varia varia Barton. Adult female 1
Taken in Albany county, November 20, 1918

, Francis B., Elsmere

Great horned owl, Bubo virginianus virginianus (Gmelin) Adult female 1
Taken at Feura Bush, November 22, 1918

m, Mrs H. D., Troy

Cardinal, Cardinalis cardinalis cardinalis (Linn) Female 1

Purchase

Birds

s, E. A., Canandaigua

Barn owl, Aluco pratincola (Bonaparte) 1
Long-eared owl, Asio wilsonianus (Lesson) 1
Short-eared owl, Asio flammeus (Pontoppidan) 1
Barred owl, Strix varia varia Barton 1
Great gray owl, Scotiaptex nebulosa nebulosa (J. R. Forster) 1
Saw-whet owl, Cryptoglaux acadica acadica (Gmelin) 1
Screech owl, Otus asio asio (Linn) 1
Great horned owl, Bubo virginianus virginianus (Gmelin) 1
All specimens taken in the vicinity of Canandaigua.

Barker, Fred, Parker's Prairie, Minn.
Mounted specimens of the following species:
Black tern, Hydrochelidon nigra surinamensis (Gmelin) Adult male and immature male
Cooper's hawk, Accipiter cooperi (Bonaparte) Immature femal
Northern pileated woodpecker, Phoeotomus pileatus abieticola (Bangs) Adult, male and female
Magnolia warbler, Dendroica magnolia (Wilson) Adult male.
Pipit, Anthus rubescens (Tunstall) Adult male

Donation

Mammals

Van Slyke, Bronk, Ravena
Woodchuck, Marmota monax rufescens Howell. Black phase.

Liske, Charles J., West Coxsackie
Woodchuck, Marmota monax rufescens Howell. Albino.

Slater, Leland S., Cairo
Red squirrel, Sciurus hudsonicus (Erxleben) Albino. Immature male

Goldring, Winifred, Slingerlands
Mouse, Mus musculus musculus Linn. Albino

Captured in State Education Building, Albany
Little brown bat, Myotis lucifugus lucifugus (Le Conte)

Purchase

Mammals

Horne's Zoological Arena Co., Kansas City, Mo.
Timber wolves, Canis occidentalis (Richardson) Adult pair and six half grown young from Montana

Ward's Natural Science Establishment, Rochester
Beaver, Castor canadensis canadensis Kuhl. Two adult, two half grown and two young

IX

PORT OF THE ARCHEOLOGIST AND ETHNOLOGIST

ne activities of this section of the Museum are subdivided into e of the office, the field, the museum and public service. The ine work in the office consists of the care and cataloging of collec-s, answering correspondence, studying specimens and preparing rts and bulletins. This work in itself is arduous and requires tant effort to perform with satisfaction. Field work consists of ining sites, excavating sites and in making studies of the Indians living within our borders. From the living Indians we obtain imens of their native arts and material that illustrates their monies and industrial activities, all aboriginal in origin and re. Museum work is that of caring for the collections, preparing exhibitions, and in adding to our store of archeological and ological material. By public service we mean the information suggestions that we constantly are supplying to federal and e departments, to organizations and specialists and to individuals. er special headings in this report the nature of some of this public ice is briefly described.

e have from time to time reported increasing interest of the ic in this section of the Museum, and we are glad to restate this . During the year just passed this interest has so greatly en-ed that we feel that the section has not only the support of those think along purely scientific lines but that of the general public. s is in keeping with the policy of the Museum to make each divi-and section of direct as well as indirect benefit to the people of State.

ublications. During the year just passed we have completed manuscript copy of "The Archeological History of New York." complete this work it has been necessary to make a reexamination nany parts of the State and to check and to verify reports of the eral thousand sites of aboriginal occupation within this State. the museums of the State were visited and the collections studied. ough these studies we have not only been able to prepare maps of various sites, individually and by counties, but to sift the evi-ces of occupation. The "Archeological History of New York" contain fairly full accounts of the various cultures that we have

determined by archeological evidences, records of the excavatio in typical sites, descriptions of the implements and utensils of t aborigines and an encyclopedic section dealing with various archeol ical topics. The task of procuring photographs has been a lengt one. More than one hundred full page plates will be used by way illustration. This bulletin is designed to be a general handbook New York archeology and it has been written for the amateur stude as well as for those with more professional interests.

The Dewey collection. During the year the Museum acquir the collection of archeological specimens made by Alvin H. Dew of Rochester. The collection came to us as the gift of Mrs Frederi F. Thompson, to whose beneficence the Museum owes several its most striking exhibits.

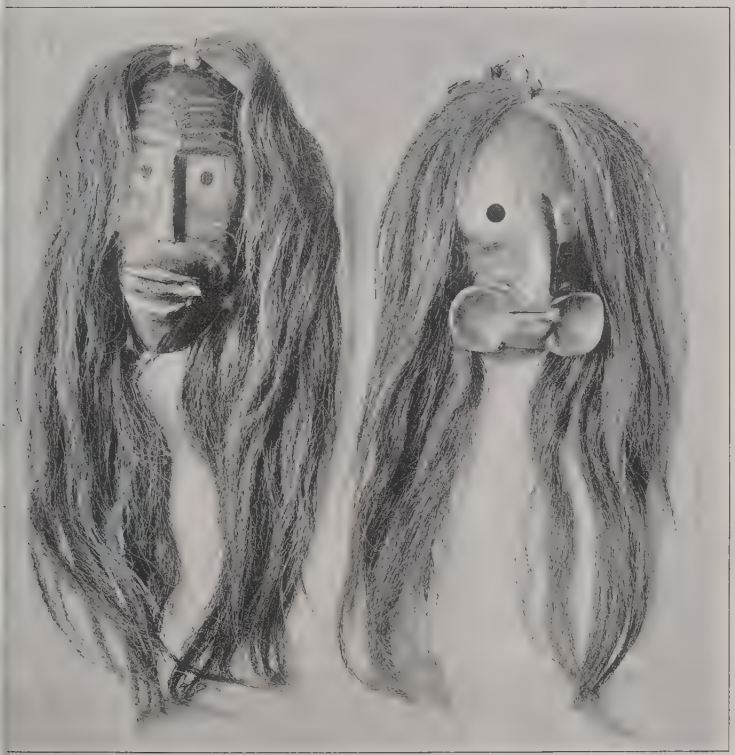
Mr Dewey specialized in material from the counties of Monro Genesee, Ontario and Livingston. Every specimen was number and its history recorded in a card index. Of all the collections th have come from private hands to the Museum this one is the mo accurately cataloged. This fact as well as the quality of the spe mens has made it a pleasant task to fit the collection into our plan exhibition.

The material in this collection is that obtained by Mr Dew personally or by excavators and collectors working under his directio The principal sites represented are Bergen, Stafford and LeRo Genesee county; Irondequoit bay, Rush, Honeoye Falls and Brighto Monroe county; Avon, Lima, Geneseo and Caledonia, Livingst county; Victor, West Bloomfield, Holcomb, Canandaigua, Richmo Mills and Honeoye lake, Ontario county.

The exploration of the principal sites, and many of those of min importance, in the area mentioned, represents about ten yea field work. The observations of the collector and of others w have examined the area and the specimens show that the region w occupied at a comparatively early time and that numerous trib and bands have swept over it, some staying longer than othe The difference between sites and the artifacts found in them striking. The differences are so great in many instances as to ma certain the wide differences in the type of culture represented. T Dewey collection contains specimens from sites showing characte istics that differentiate them from those of any identified cultur Other sites may with varying degrees of certainty be attributed known cultures; thus, we may point out sites that are Eskimo-lik Algonkian, Mound Builder and Iroquoian. In some instanc

Seneca specimens collected by A. C. Parker. 1 Ceremonial ladle; 2 Quilled moccasins.

Feather wands used in the Bird dance. Cattaraugus Seneca, 1919.



sks of the False Face Company. 1 Tonawanda Seneca; 2 Cattaraugus Seneca. Both are more than a century old.

different stages or periods of definite occupation may be noticed. For example, we are able to trace the Iroquoian from prehistoric to recent times and note the shifting of art motives and the acquisition of new forms as well as the disappearance of older ones.

The Dewey collection contains a number of especially fine polished slate articles from the lower valley of the Genesee. Among these may be mentioned semilunar knives, gorgets, bird stones, banner stones, pendants, boat stones and other problematicals. Numerous specimens in this collection have been used in illustrating articles on New York archeology.

The semilunar knives are especially fine specimens. One, somewhat smaller than the rest, is of black slate and has a limestone inclusion that spreads out in a quaint oriental pattern. The maker of the implement seems to have preserved this marking for its decorative effect. These implements came from sites that resemble those of the Eskimo. The arrow points associated with them are broad. Hammerstones are found with them, some soapstone pottery, but no bone and no clay pottery.

Among the material of the later period are a dozen or more pipes. These are principally Iroquoian, though there are one or two that come from Mound Building sites. The effigy pipes from Iroquoian sites are typical in motive though some of them are unique. One pipe has modeled upon it two heads, one male and the other female. The form is the triangular hooded face. Other pipes are the familiar ringed bowl and the serpent pipe. One pottery vessel in the collection came from the Marsh site at East Bloomfield. This site is that of Gandaguare, the village of the captive Neutral and Huron Indians. It has four upturned corners and its outer surface is decorated.

For the purpose of preserving his specimens Mr Dewey had many of the finer objects, including some that were fragile, framed in deep mounts that held the specimens away from the cover glass. One of these frames is shown in one of the accompanying plates. The objects came from the John Dann site near Honeoye Falls. The comb in the center is unbroken, in this respect being quite unusual.

The value of this collection lies in its wealth of type specimens from a definite locality. The careful manner in which it is cataloged preserves the record of each specimen and lends added value to the collection from a scientific and historical standpoint.

Other acquisitions. Several smaller collections have been added to our accessions, both by gift and by purchase. We have been especially fortunate in the field in both the departments of archeology

and ethnology. During the winter months of 1918–19 a number of exceptionally fine ethnological articles were acquired from the Indians on the Tonawanda and the Cattaraugus reservations.

At Cattaraugus reservation during the midwinter ceremony in January 1919, an almost complete set of the paraphernalia of the Medicine Lodge was collected, including a flute, medicine bag, knot cup and feast ladle. Other unique articles were bird dance wands with eagle feathers having the handles decorated with quilled ornamentation.

One of the finest small collections found on the reservations was that in possession of an elderly Indian woman at Tonawanda. All the specimens are old and were made and used by the Seneca during the early years of last century. The articles include a rare wood mask, a very fine baby cradle board, a beaded sash, husk trays, strands of wampum, beaded cradle board wrappings, wooden dolls, game javelins, and wooden spoons. (Presented by Mrs Frederick F. Thompson).

Of considerable importance to our Museum is a mound pot found in a small burial mound near Vandalia on the Allegany river. This vessel, though entire when found, was broken slightly by the finder. It has been restored so that for all purposes it is as good as perfect. It is the only complete mound pot from the State of which we have any record.

A small wampum belt was presented by the estate of Mrs Abraham Lansing. It is reported to have been one of the belts used at the treaty of Fort Stanwix. The belt is 49 centimeters in length and 7 beads or 5 centimenters wide. The decoration consists of three purple bars on a field of white beads.

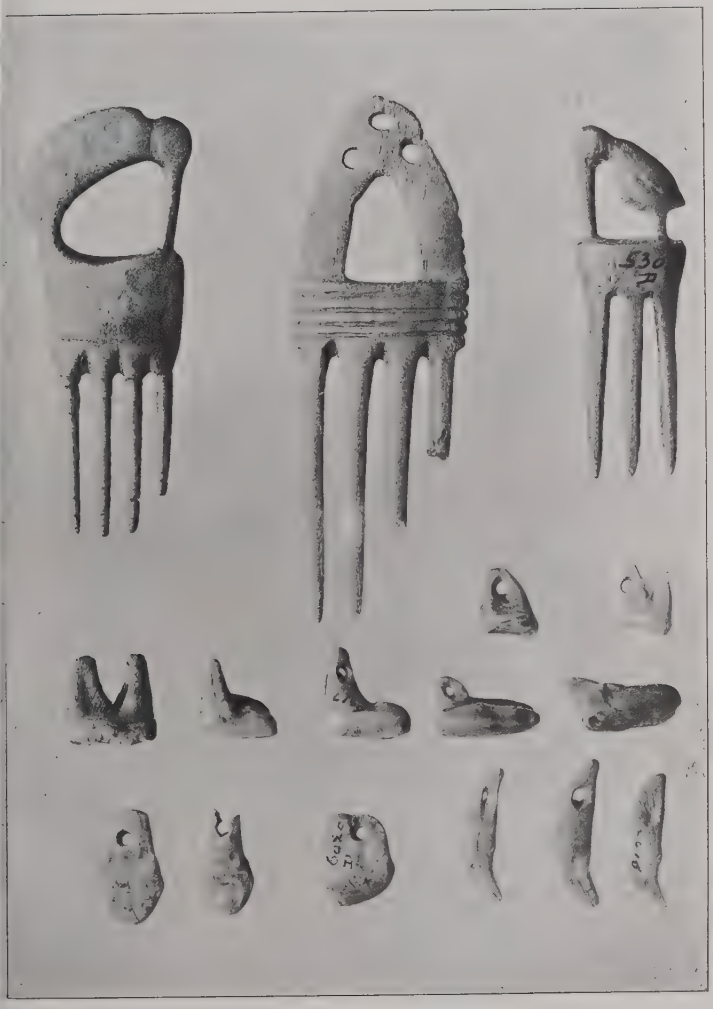
Cooperation with federal and state departments. This division of the Museum has grown to be a repository of information not only concerning the archeology, ethnology and history of the New York aborigines, but also concerning the present condition and legal status of the Indians of this State. This is of value and of importance to the people of the State and to the various administrative departments.

We have frequently supplied information, opinions and copies of treaties to the Attorney General's office, in connection with matters that have come before his office for review or opinion. Anticipating requests of this kind we have taken occasion to keep on file such books and documents as may be of service. During the progress of the war we were called upon for information and for opinions respecting the legal status of the Indians of the State,

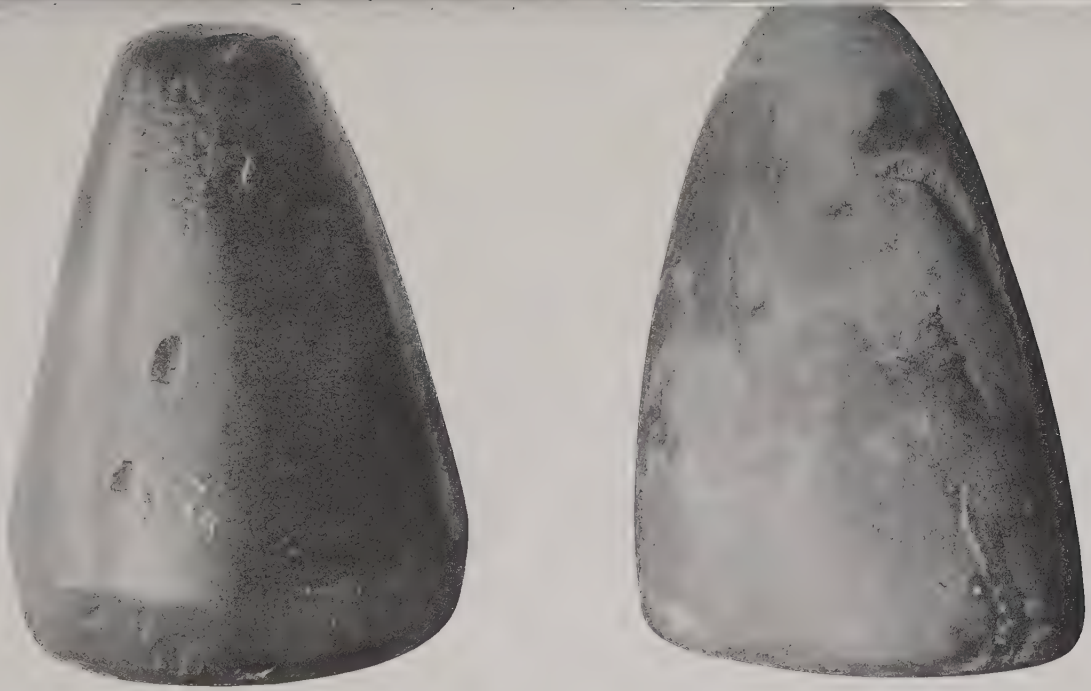
Pipes from the Alvin H. Dewey collection. 1 and 2 are from the Dann farm site, Honeoye Falls; 3 is from Leroy.

Bone articles revealing the process of making fish hooks. From Richmond Mills. Dewey collection.

Frame containing grave finds from Honeoye Falls. Dewey collection

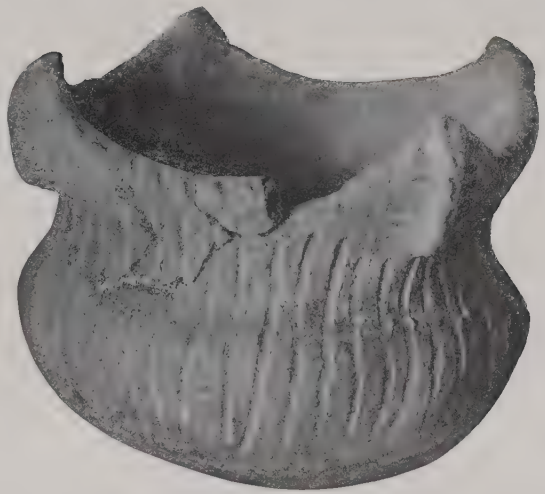


Antler and tooth ornaments from the Dewey collection



Mullers or grinders from Stafford. Dewey collection

1 Pottery bowl from a mound at Vandalia.



2 Pottery bowl from a grave on the Marsh farm, East Bloomfield.

y the Adjutant General's office, and supplied him with briefs and ocuments setting forth the position of the Indians with respect to he draft act. Later for the federal selective service bureau, we applied information and devised plans for the notification of the ndians of the State of the necessity of registration. This service was rendered for the three periods of registration. In order to ee that the registration was properly conducted and that the Indians esponded, the Archeologist was appointed inspector of the draft oards of the counties of Chautauqua, Erie, Cattaraugus, Genesee, Niagara, Onondaga, Oneida, Franklin and St Lawrence.

Certain other services have been rendered to the State Health Department, especially in the matter of supplying information as o the sanitary and health conditions of the various Indian reser vations. In behalf of the Indians and at their request their needs have been brought to the attention of the Attorney General's office, he Governor, the Charities Department, the Agricultural Depart ment, and the Education Department. This division constantly cooperates, in matters which concern the subjects of archeology, ethnology, colonial history, and present-day Indian affairs, with he various divisions of the Education Department, particularly he State Librarian, the State Historian and the Examinations and Inspections Division.

Requests from Indians. The information available in this division has made it the source of relief to the various Indian tribes still living within the State, especially when data on historical subjects are needed. We have been prompt to supply these inquirers with the best advice and the most reliable information within our ability to give. Our publications and our exhibits are also used by the Indians as authentic guides in tribal matters. Not only the Indians of our State, but those of other states and of the Canadian provinces seek information here. For help given the Mohawks of the Bay of Quinte, the Archeologist has been given membership in the tribe and appointed the representative of it in the United States.

A notable adoption ceremony. It has been thirty years since the Seneca Indians have held a notable adoption ceremony in which large numbers of the people participated. On June 22, 1918 some of the Senecas decided to hold such a ceremony and to adopt Mr George K. Staples and Mr George L. Tucker, both of Buffalo. Mr Staples and his ancestors for many years have been interested in the welfare of the Seneca Indians of western New York and were among the Quaker pioneers who befriended the red men in time of dire need. Mr Tucker is an archeologist and student of the Iroquois and par-

ticularly the friend of the Indian children. It was decided to make Mr Tucker a member of the Bear clan and take him into the family of William Tallchief. Mr Staples was selected by the Turtles and made a candidate for membersip in the Turtle family of David George. There were elaborate ceremonies at the Thomas Indian School, and despite the heavy rain, there was a large attendance. Many prominent persons from the nearby region were present and numerous well-known men and women came from Buffalo. The initiatory ceremony consisted of a pageant descriptive of the methods by which the Indians had become transformed from their original condition to that of civilization. Later the ancient adoption rite was performed by Chief David George. In all the previous ceremonies there had been three candidates. To the surprise of the venerable missionary, the Rev. J. Emory Fisher, he was called to the rostrum, given the oath of friendship and allegiance to the Senecas, and adopted with Messrs Staples and Tucker. At the close of the ceremony Mr Tucker distributed a large number of presents to the assemblage, providing every Indian man, woman and child with a suitable gift. Newspaper men and photographers made records and photographs of the ceremony and a moving picture concern made a film in order to preserve in a pictorial way some of the episodes. The Archeologist was present and made full notes for preservation in the archives of the Museum.

Death of Chief Edward Cornplanter. During the month of June 1918, Edward Cornplanter, or So-son-do-wa, for many years an authority on ceremonial matters, passed away. He was in many respects a remarkable man and his knowledge of the ancient rites of the Seneca brought him not only a widespread acquaintance with all the various branches of the Iroquois in New York and Canada, but brought to his home numerous students of ethnology. Cornplanter was the friend of the State Museum and cooperated with it in many important attempts. It was he who supplied the text of Bulletin 163, "The Code of Handsome Lake," much information on the subject of maize and other plant foods, and many of the myths and tales now among our accessions. Jesse Cornplanter, his son, made the native drawings for Bulletins 125, 144 and 163. About three years ago Cornplanter became ill and soon became an invalid. At first no grave consequences were anticipated and thus his son Jesse joined the colors of the national guard as a volunteer and early went to France where he served as a corporal. Jesse could not return to care for his father nor could he attend the funeral. Soon after Cornplanter's death his wife Nancy became a victim of the influenza

demic, all the children and grandchildren died save one married ughter, and two little grandchildren. Of the large Cornplanter nily that Corporal Jesse Cornplanter left, only one sister will greet ; return, and there will be two destitute children of a dead sister to :e for. This is a tragedy in peaceful America that a returning neca warrior must face.

The Lewis Henry Morgan centennial. The year 1918 marked the ntennial anniversary of the birth of Lewis Henry Morgan. Mor- n's achievements as an ethnologist at a time when there was no ganized science known as ethnology, entitle him to grateful recog- tion. Through his study of the New York Iroquois he laid the sis of a life work that resulted in the publication of numerous pers, reports and volumes dealing with Indian topics. His first eat work, " The League of the Iroquois " was the first systematic count of an Indian tribe ever published and an estimate of its portance in later years has given to Morgan the title, " the father American anthropology."

Mr Morgan in 1849, through the aid of James Hall, State Geologist, as commissioned by the Regents to make a systematic collection Iroquois ethnological material. This Morgan did, collecting his aterial not as former collectors had done, merely as curious examples native art, but in so thorough a manner that his collection, once ranged, illustrated the raw materials, the processes of manufacture id the varieties of the finished products of the tribes he studied. Morgan seems to have been the first to recognize the value of detailed udies of the material culture of a people. He looked at the culture s a concrete whole, to be understood only by an examination of all s constituent parts. Morgan communicated his reports to the ate Museum in the second, third and fifth reports of the Museum, id these were the first scientific papers of notable merit thus pub- shed. Some of Morgan's later works were, " Systems of Consan- uinity and Affinity of the Human Family," Smithsonian Contri- utions, volume 17 (1871); "Ancient Society," Henry Holt (1877); Houses and House Life of the American Aborigines," volume 4 of ne United States Geological Survey (1881).

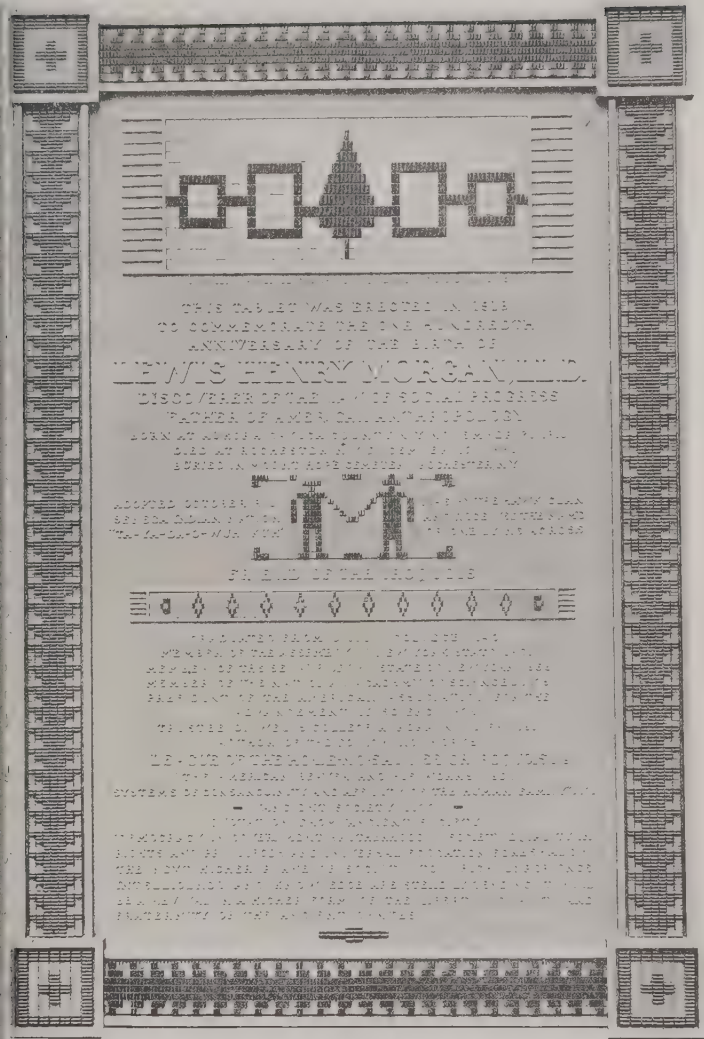
Some of these have been translated into foreign languages. This particularly true of "Ancient Society," which has passed through umerous editions in foreign languages as well as in English. The League of the Iroquois," however, has been the most popular of his orks and has won him wide recognition among students of American rcheology and ethnology.

Lewis H. Morgan was born in Aurora, N. Y., November 21, 181
He was educated in Cayuga Academy and Union College, bein
graduated from the college in 1840. In 1875 he received the degre
of LL.D. from his alma mater. He made his home in Rochester, afte
his admission to the bar. In 1855 he became legal adviser to th
railroad and iron interests in the Marquette region of Lake Superio
During this period he had abundant opportunity for making studie
among the western Indian tribes. In 1861 he was elected to th
Assembly of New York and in 1868 to the State Senate. Morga
early became interested in the Seneca Indians and rendered them
several notable services, leading to the preservation of their lands i
this State. In 1847 the Senecas adopted him into the Hawk cla
bestowing the name Ta-da-ya-wah-kuh, "One-lying-across," i
allusion to his services as intercessor.

Interest in Morgan and his work has been revived by the Ne
York State Archeological Association, especially by Lewis H. Morga
chapter of Rochester. For several years this chapter has place
memorial wreaths on Morgan's tomb. A large wreath was place
upon the gate of the tomb in 1918, commemorating the 37th anniver
sary of his death and the 100th of his birth. Morgan die
December 21, 1881.

On June 10, 1919, the Lewis Henry Morgan memorial committe
presented to Wells College at Aurora a memorial tablet setting fort
the career of Morgan. The members of this committee were Willia
Fellowes Morgan of New York, Dr Robert L. Zabriskie of Aurora
Arthur C. Parker of the State Museum, Albany, Dr Allen M. Dulle
of the Cayuga County Historical Society, Auburn, Herbert M. Lloy
of Montclair, N. J., Dr Rush Rhees of Rochester University, Alvi
H. Dewey of Morgan Chapter, N. Y. S. A. A., Rochester, E. R
Foreman of the Rochester Historical Society. The active officers o
the committee were Dr Kerr D. MacMillan, president of Wells Colleg
E. H. Gohl, secretary, and N. Lansing Zabriskie, president of th
Aurora National Bank, treasurer.

The tablet was designed by E. H. Gohl of Auburn and was to hav
been placed on November 21, 1918, the centennial of Morgan's birth
Delay in casting, however, forced the later date. The unveiling wa
witnessed by a large audience which included the student body an
graduates of Wells College. The principal address was made b
Prof. Roland B. Dixon of Harvard University and the address o
presentation and unveiling by the Archeologist of the State Museum


THIS TABLET WAS ERECTED IN 1919
TO COMMEMORATE THE ONE HUNDREDTH
ANNIVERSARY OF THE BIRTH OF
LEWIS HENRY MORGAN, LL.D.
DISCOVERER OF THE LAW OF SOCIAL PROGRESS
FATHER OF AMERICAN ETHNOLOGY

The Morgan Memorial Tablet, placed in Wells College, Aurora, June 1919

Aurora was the birthplace of Morgan and his home yet stands in od repair. He was from 1868 to the time of his death in 1881 a ıstee of Wells College.

Morgan was the father of the archeological and ethnological depart- ents of the State Museum and the collections that he brought gether formed the first Indian exhibits in the Museum. Through is collection and through his reports Lewis Henry Morgan will ways be associated in the minds of scholars with the New York ate Museum.

The Cornplanter medal. The Cornplanter medal is a biennial ward bestowed upon some noted student of the Iroquois history anthropology. The bestowal is made by the Cayuga County istorical Society upon the nomination of its executive staff and rof. Frederick Starr of the University of Chicago. The medal was riginated by Doctor Starr and endowed through the sale of copies drawings made by Jesse Cornplanter, the great grandson of the lebrated Chief Cornplanter. The medal was named after the ornplanter, the friend of George Washington.

In considering candidates the committee determines the value of ıeir re searches and attainments in several lines, among them the llowing: contributions to an advancement of the knowledge ncerning the Iroquois, literature, philanthropy. The medals have een bestowed upon the following persons: General John S. Clark f Auburn, Dr David Boyle of Toronto, Reuben Gold Thwaites of incinnati, William M. Beauchamp of Syracuse, William Pryor etchworth of Portage, John N. B. Hewitt of Washington, Arthur . Parker of Albany. This year at the Morgan centennial the medal vas bestowed upon Alvin H. Dewey of Rochester for his notable chievements in organizing the New York State Archeological Associ- tion, in bringing together students of aboriginal archeology and eth- ıology and in publishing the records of various surveys of sites in vestern New York. The medal was given at the time of the unveil ng of the Morgan tablet, June 10th, a most fitting time to pay ribute to the organizer and president of Lewis H. Morgan chapter.

The New York State Archeological Association. The membership of this association is composed of two classes, general members and chapter members. There are at present two active chapters and two in process of formation. Leatherstocking chapter at Coopers- own has its headquarters at the Chamber of Commerce rooms and ıolds monthly meetings either there or at the home of its president, David R. Dorn. It is devoting its energy to making a systematic

study of the archeology of the upper Susquehanna. The secretary is Rowan D. Spraker and the attorney, Adrian A. Pierson. Morgan chapter, the parent organization, is located at Rochester. Meetings are held monthly during ten months of the year, two of which are field meetings. Special students and experts on archeological subjects give the addresses. During the year meetings have been held at Rochester University, the Rochester Club, the Municipal Museum, Catherine Strong Hall and the Memorial Art Building. All other meetings, except field meetings, have been at the home of President Alvin H. Dewey, who seems to delight in providing entertainment and refreshment for his fellow students.

The Archeologist of the State Museum is the acting director of the association and has attended the annual meetings of the chapters as well as given talks at stated meetings. The association headquarters is at the State Museum where the records are kept. The association is performing a remarkable work and is cooperating with the State Museum in obtaining information and specimens. The Museum is fortunate in having so large a body of enthusiastic friends.

Addresses and papers. There is a constant demand for articles and lectures on subjects pertaining to the New York Indians, past and present. The heavy demands of the routine work of the department make it impossible to respond to more than a very few of these requests. During the year the Archeologist has prepared the following papers for publication: A Prehistoric Iroquoian Site at Richmond Mills, Ontario County, New York State Archeological Association Transactions; the New York Indians in the World War, "State Service," November 1918; Museum Groups in Wax and Plaster, "Museum Work," December, 1918; An Early Contact Period Site of the Seneca at Factory Hollow, New York State Archeological Association Transactions, 1919; Health Conditions of the New York Indian Reservations, "Health News," April 1919.

Public addresses have been: The Religious Beliefs of the American Indians, Unitarian Society; Primitive Secret Societies, Leatherstocking chapter; Origin and Distribution of the American Indians, Morgan chapter; The Empire State When the Red Man Ruled, Buffalo consistory; The American Indian in the World War, Morgan chapter. These talks were given in order to stimulate interest and to supply correct information. No fees were received and traveling expenses in no case were made a charge upon the State.

ACCESSIONS TO THE COLLECTIONS OF ARCHEOLOGY

Collection

A. C. Parker, Archeologist, Albany

Mound builder pot	1
Seneca pot, broken	1
Pipe, Iroquoian	3
Grooved axe	2
Celts	5
Spear points	20
Shell ornaments	6
Catlinite ornaments	4
Stone ball	1
Bone implements	14
Metates	2
Hammer stones	12
Pestles	2
Arrow points	247
Net sinkers	15

Donation

The A. H. Dewey Collection; gift of Mrs F. F. Thompson, Canandaigua

Honeoye Lake, Ontario county

Anvils	2
Arrows	2
Arrows and spears	30
Celts	9
Drills	7
Beveled celts	2
Bolo stones	3
Flint disk	1
Flint knife	1
Grooved maul	1
Gun flints	3
Metates	5
Hammer stones	16
Knives	2
Net sinkers	2
Muller	2
Metal comb	1
Pitted stone	17
Pipe bowl	1
Pipe stems	4
Pestles	5
Pendant	1
Potsherds	3
Rubbing stones	5
A string of wampum glass and bone beads	1

Sinkers	10
Stone disk	1
Tibe stone	1
Triangle points	8
Stone objects	2
Smoothing stone	1

Victor, Ontario county

Arrows	6
Bone awl	1
Brass triangle points	1
Bone comb	1
Bone implement	1
Bone spear head	1
Bone pendant	1
Bone pipe	1
Clay effigy	1
Effigy pipebowl	1
Flints	3
Flint drill	1
Copper bangle	1
Gun flints	2
Iron adze	1
Lead	1
Deer's spine	1
Deer antler awl	1
Horn pottery marker	1
Bone needle	1
Bone puncher	3
Worked bone	3
Bear's teeth	15
Bullet mold	1
Metal button	1
Potsherds	11
Pipes	6
Pipe bowls	6
Pipe fragments	2
Shell ornament	1
Clay pipe stems	27
Pipe stems	5
Turtle shell	1
Trade axe	1
Triangle points	3
Sharpening stones	4

Rochester Junction, Monroe county

Arrow	1
Brass kettle	1
Beveled celt	1
Bear's teeth	2

Bear paws	2
Brass ornaments	7
Clay effigy	1
Copper awl	1
Copper fish hook	1
Gun flint	1
Brass arrows	8
String glass beads (605)	1
Iron implement	1
Bone implement	1
Brass and copper pendants	8
Projectile points	17
Copper and brass beads	1
Raccoon bone	1
Hafted sheet awl	1
Iron awls	3
Pipe stems	16
Potsherds	1
Shell runte	2
Shell beads	12
Spiral shells	1
Trade axe	1
Triangle points	28
Worked bone	3
String beads	1

Cleary, Livingston county

Brass pendants	4
Brass projectile points	2
Charred corn	
Flint saws	2
Flint objects	4
Hammer stones	1
Bone beads	2
Game button	1
Beaver's tooth	1
Pendant	1
Rubbing stone	1
Pottery bead	1
Arrow	1
Sharpening stone	1
Scrapers	3
Triangle points	69
Stone bead	1
Bone awls	8
Iron trade axes	2
Copper triangle point	1
Copper pendant	1
Pipe stems	14
Pipe bowl	1

Potsherds	3
Bone ornament	1
Bone pendants	2
Bone implements	5
Bone punch	1
Elk's teeth	2
Bear teeth	3
String, 25, copper and glass beads	1

Dann site, Honeoye Falls, Monroe county

Bone combs	3
Bullet	1
Couch shell beads	2
Catlinite beads	3
Hammer stone	1
Human bones	2
Brass bells	2
Brass thimbles	5
Bullet punch	1
Banner stone	1
Frame of beads and bone comb	1
Frame of beads	1
Frame of 6500 wampum beads	1
Frame of beads and bone ornaments	1
Wampum 50 strings of (55) beads each	50
Plovers and wampums	quantity
Brass kettles	2
Copper pot	1
Smoothing stone	1
Old button	1
Stone bead	1
Slate bead	1
Shell gorgets	3
Shell face	1
Shell pendants	3
Shell ornament	1
War paint	1
Gun stock	1
Iron axe	1
Iron implement	1
Shears	3
Copper bracelet	1
Iron chisel	1
Iron bracelet	1
Iron drills	1
Knives	7
Lead tubing	1
Iron rimmer	1
Section ramrod	1
Parts of a gun	1

omb, Ontario county

wl copper	1
row copper	1
ear's teeth	2
rass triangle points	10
eads	16
rass kettle	1
rass thimble	2
ox turtle shell	1
one spoon	1
ullets	3
rass bells	2
opper pendant	1
opper pieces	5
opper fish hook	1
rame of 2788 beads	1
lint chippers implement	1
lass beads	4
harred corn	1
lammer stone	1
ron crane	1
ron adzes	3
esuit ring	3
ead bullets	33
Mica	1
Problematical objects	4
Potsherds	11
Pipe bowls	2
Pendants	3
Pipe	1
Pipe stem	1
Tube pipe	1
Powder, quantity	1
Pottery vessel	1
Sharpening stones	4
Stone pendant	1
Shell ornaments	2
Shell pendants	8
Shell crescents	6
Stone rattles	7
Skull	1
Leg bones	2
Animal teeth	3
Thimble	1
String of 4625 beads, ornaments etc	1
War paint, quantity	1

ichmond Mills, Ontario county

Bone awls	171
Arrows	2

Bone arrows	
Combs	
Ceremonials	
Fish hooks	
Fish hooks, not completed	
Harpoons	
Hairpins	
Incising tool	
Tallies	
Ornaments	
Pendants	
Whistle	
Needles	
Scrapers	
Beads (bone) 330 in strings	
Beads 25 on string	
Perforated animal teeth	
Punches	
Flaking tools	
Implements, various kinds	
Animal bones, various kinds many worked	
Miscellaneous articles	
Horn implements	
Handle of implement	
Raccoon bones	
Bears' teeth	
Celts	
Chisel	
Clay effigies	
Clay pipe stems	
Disks	
Discoidal stone	
Gorget	
Game stone	
Hammers	
Sharpening stones	
Scraper	
Spear	
Slate implements	
Pestle (fragments)	
Net sinkers	
Whetstone	
Flaking implements	
Punch	
Miscellaneous stone materials	
Pipe bowl fragments	
Steatite object	
Hammer stone	
War clubs	
Flint saws	

Flint disks	7
Pipes	8
Pottery beads	2
Pipe bowls	10
Metates	7
Anvil	1
Mortar	1
Muller	1
Pitted stones	17
Sinker	1
Groved spade	1
Chipped disk	1
Palletti stone	1
Triangle points	18
Ivory objects	2
Effigy clay pipe	1
Pottery disks	2
Pottery bead	1
Miscellaneous clay objects	5
Potsherds	69
Worked shell	1
Shell disk	1
Shell beads	40
Elks' teeth	11
Stone beads	16

ctory Hollow or Shattuck site, Ontario county

Awls	18
Bears' teeth	2
Catlinite beads	4
Catlinite eagle effigy	1
Effigy bone baby	1
Hammer stones	2
Bone fish hook	1
Bone projectile points	3
String 110 glass beads	1
Gaming stone	1
Clay pipe bowls	2
Clay pipe	1
Brass points	10
Copper pendant	1
Gun flint	1
Drill	1
Iron knife	1
Chisel	1
Metal pendant	1
Metate	1
Muller	1
Pipe bowls	5
Pipe stems	3

Punch	1
Scraper	1
Sharpening stones	11
Smoothing stones	6
Sinker	1
Silver coin	1
Brass saw	1
String 290 handmade wampum beads	1
Triangle arrows	1
Celts	11
Effigy bone face	1
Bone candles	10
Implement	1
Worked bone	9
Bone head	2
Elk tooth	1
Bone pendants	2
Flaking tools	6
Bone needles	1
Bone punches	3
Bone implements	2
Perforated bear tooth	1
Teeth	6
Bears' teeth	5
Beaver's teeth	2
Raccoon bone	1
Bone gouge	1
Pottery fragment	1
Potsherds	54
Horn punches	2
Bones (worked)	1
Iron chisel	1
Iron implement	1
Brass pendant	1
Brass awl	1
Clay effigies	4

Miscellaneous material from various localities in New York State

Arrows	235
Bone arrow	1
Arrow straightener	1
Arrow shaft grinder	1
Copper awl	1
Awls	1
Bone awls	26
Grooved axes	15
Trade axes	2
Bird amulet	1
Bar amulet	1
Beads	36

tlinite beads 13
ell beads 5
ad beads 1
pper beads 6
ass beads 3
ne beads 9
one beads 4
lts 178
veled celts 25
ooved celts 1
remonials 6
ell pendants 3
tlinite pendant 1
one pendant 1
uges 26
ring of 93 wampum beads 1
ring of 160 shell wampum beads 1
ring of 32 beads of assorted materials 1
ring of 35 beads and catlinite pendant 1
ring of 30 beads 1
ring of glass and bone beads 1
ring of shell crescents and beads 1
ring of beads 4
ame of spears, arrows and drills 25
ame of arrows 18
ame of beads and bone ornaments 1
ame of perforated bears' and wolves' teeth 1
ame of arrows and spears 1
one (worked) 5
one combs 3
one ring 1
one effigy 1
one implements 17
one needles 4
one pendants 2
one phalanxes 2
one harpoon 1
one ornaments 3
one punches 2
on adzes 3
ass kettles 6
ass points 2
ass chain 1
ass bell 1
ass and copper points 6
opper bangles 3
nner stones 8
allets 3
utton 4
ood bowl 1

Bolo stones
Belt
Section bird stone
Ceremonials
Copper buttons
Chisel
Clay vessel
Cloth
Disks
Drills
Discoidal
Clay effigy
Lead effigy
Face
Effigy bird pipe
Effigy pipe fragment
Clay pipe effigy
Flints
French coin 1656
Flint blades
Gun flints
Gorgets
Gamestone
Hammer stones
Grooved hammer
Harpoons
Stone hatchet
Notched hoe
Iron chisel
Slate and stone implements
Iron spoon
Jesuit cross
Jesuit rings
Jews'-harps
Flint knives
Iron knife
Knives
Semilunar knives (ula)
Lead ladle
Metates
Maul
Mullers
Mortar
Grooved maul
Grooved net sinker
Potsherds
Tube stones
Pendants
Pipe effigy bowls
Pipe bowls

tite pipe (fragment)	1
s (entire and broken)	34
-faced effigy pipe	1
of a rare pipe	1
e pipe	1
pipe stems	19
faced pipe bowl	1
bowls (fragments)	7
mplanter's tomahawk pipe	1
les	2
vers wampum	1
ed stones	5
nt	4
nt pestles	2
tery vessel	1
ed stones	12
les	16
dants	13
llic stone	1
ecklace of 15 ivory disks	1
ler pestle	1
ects	1
bing stones	3
w stone	3
de	1
kers	17
oved sinkers	9
apers	3
atite objects	2
ssors	1
ars	95
te ceremonial	1
rpening stones	4
lls	6
d of spears and arrows	10
ndle wheel	1
pper spears	2
be	1
ars' teeth	4
be stone	1
atite tube	1
's tooth	1
n tomahawks	3
e tomahawk	1
r clubs	2
angle points	25
scellaneous material from various localities in New York State	247

ACCESSIONS TO THE COLLECTIONS OF ETHNOLOGY

Collection and Purchase

A. C. Parker, Albany
- Silver brooches
- Wampum wristband
- Masks, ceremonial
- Wooden ladles
- Feather wands
- Belt, beaded
- Husk basket
- Wooden cup
- Buckskin bag
- Smoking pipe

Donation

George L. Tucker, Buffalo
- Clay pipe, face effigy, found at Belmont, Allegany co

John Brooks, Albany
- Arrowpoints from Indiana

Mrs Abraham Lansing Estate
- Wampum belt used at Fort Stanwix

Mrs F. F. Thompson, Canandaigua. The Laura Doctor collection
- Mask
- Spoon
- Cradle board
- Cradle wrappings
- Flute
- Dolls, carved
- Canoes, miniature
- Scalping knife
- Husk basket
- Husk tray
- Bark tray
- Wampum strings
- Splint basket, small
- Water drum
- Javelins
- Net hoop
- Snowsnake
- Burden strap
- Rattle, turtle
- Box turtle rattle
- Rattle, calabash

X

STAFF OF THE DEPARTMENT

The members of the staff, permanent and temporary, of the Department as at present constituted are:

ADMINISTRATION

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Bob Van Deloo, Secretary and Director's Clerk
Dina M. Tolhurst, Stenographer

GEOLOGY AND PALEONTOLOGY

John M. Clarke, State Geologist and Paleontologist
David H. Newland, Assistant State Geologist, Curator of Geology
Rudolf Ruedemann, Assistant State Paleontologist, Curator of Paleontology
William L. Bryant, Honorary Custodian of Fossil Fishes
John A. Hartnagel, Assistant in Geology, Curator of Stratigraphy
Herbert P. Whitlock, Mineralogist, Curator of Mineralogy
George S. Barkentin, Draftsman
Sarah T. Clarke, Technical Assistant
Winifred Goldring, Assistant in Paleontology
John C. Wardell, Preparator, Assistant Curator of Paleontology
Charlotte F. Gorman, Stenographer
Charles P. Heidenrich, Mechanical Assistant
Edmund V. Lewis, Clerk
John L. Casey, Custodian
William Rausch, Cabinet Maker
Harry Hayes, Laborer
Edward Noxon, Laborer

Temporary Experts

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Prof. W. J. Miller, Smith College
Prof. G. H. Hudson, Plattsburg State Normal School
Prof. W. O. Crosby, Massachusetts Institute of Technology

Prof. George H. Chadwick, Rochester University
Prof. John L. Rich, University of Illinois
Prof. A. F. Buddington, Brown University

Economic Geology

Prof. Nelson C. Dale, Hamilton College
Harold L. Alling, Columbia University
R. J. Colony, Columbia University
Prof. C. H. Smyth, jr, Princeton University

Geographic Geology

Prof. Herman L. Fairchild, University of Rochester
Prof. James H. Stoller, Union College

BOTANY

Homer D. House, State Botanist
Louis Robbins, Assistant, Curator of Botany

ENTOMOLOGY

Ephraim P. Felt, State Entomologist
D. B. Young, Assistant State Entomologist, Curator of Entomology
Fanny T. Hartman, Assistant Curator of Entomology
Helen L. Ryan, Stenographer
Matthew J. McGarry, Page

ZOOLOGY

Sherman C. Bishop, Zoologist, Curator of Zoology
Benjamin Walworth Arnold, Honorary Curator of Ornithology
Arthur Paladin, Taxidermist

Temporary Experts

Dr H. A. Pilsbry, Philadelphia.
Silas C. Wheat, Brooklyn
Roy W. Miner, New York

ARCHEOLOGY

Arthur C. Parker, Archeologist, Curator of Archeology and Ethnology

Temporary Assistant

Anna C. Parker, Delmar

XI

SCIENTIFIC PAPERS

OSTBELLUM REFLECTIONS ON THE PLACE OF PALEONTOLOGY AMONG THE SCIENCES

BY JOHN M. CLARKE

sented before the Paleontological Society, Washington, December 1918)

s we pressed into this late war and while in the midst of its ors, we set ourselves to determine what service there lay within which could be turned to its ends and when we found such knowl- e or such competency, we laid it forthwith at the command of military establishment. I do not mean to ask how many of us nd ourselves possessed of a war-time serviceability, how far our cial knowledge was or could be adapted to the call of the time, how remote it may have been regarded in the bustling haste with ch the country enlisted in this all-absorbing enterprise. We rched ourselves; we entered into every cranny of our storehouse discover where lay some hidden, perhaps forgotten potency which ght now be drawn into the country's service.

The sword had been thrust in our hand; it was an unfamiliar tool l the part for which we were cast was obviously to mend, not to r. Feverish with desire to serve, we turned to the uncounted l incessant civilian activities essential to the great struggle. For se we strained our thought and our help, for them we saved and renched, while over and through, about and in all these activities s the ever-present horror of a world submerged in a welter of crime of which rose the thundering approach of retributive justice. en suddenly the alert resounded and the great fight was done. if over night, it seemed, in the very heart of infinite preparations l amid the blaze of uncounted miles of battle line, the powers of kness succumbed.

Now what was the first reaction upon you when the truth of tory was secure? After the sigh of relief from overburdened rts had transformed itself into a shout of joy and the high pressure s released, which way did your thoughts turn? I have heard a eontologist whose total energies had been given over throughout

this period of trial to the organization of helpful activities, say that he at once buried himself in his scientific manuscripts in a delirium of detachment like absorption in a great poem. Was this not true of all of us? The burden lifted, the night past, we reveled again in the sun.

It has been my constant argument in season and out of season, in the presence of the members of our own craft and of those uninstructed in this faith, that this science of ours, which is the key to the historic development of life and of the continents and seas which have nourished it, carries with it fundamental conceptions which must indicate the correct relations of man to himself, to his neighbors and to his intellectual and spiritual purposes. This is, I believe, a sound proposition. But the belief itself does not make us righteous nor does the practice of our profession of itself impart righteousness. The search for and the finding of the truth is only an interesting diversion unless that truth is made vital in application.

The pursuit of science does not, alas, raise a man to the practice of a higher morality and it has no power to enlarge the soul of the man whose concern therein is only the acquisition of new information. But truth of the sort that we do pursue and find does have an engendering virtue in its application and it should broaden our perceptions of our own place and our own influence. The laws of sin and righteousness, the continuity of the struggle betwixt the physically good and the evil and hence between the spiritually good and the evil, the correctness of adaptations and the disasters of misfit, are ever present in this panorama of life to him who will not let his vision be eclipsed by details. If an undevout astronomer is mad, then surely a biologist dealing with the transformations and permutations of a living world, if not spiritually uplifted must be a dullard; and so we who have been detailed to chart the march of life in its courses through the ages possess the competent basis of a true philosophy.

Science, whom once the president of the United States called an "ascetic nun," has in these days left her attic and come down on the street; with the glowing red symbol of the cross on her somber garment she who represents us has done what she could in ministry to the hurts of war. She of our science does not belong with the Battalion of Death. We can not and do not need to impress on the industrial world the larger importance of these principles that engage us. If we are sure that this science of the progress of life carries with it the guy-lines of our future progress; indeed even if we are not so sure of this but may reserve such progress to the overcontrol of the

intellect; in either case our articles of faith are of the first of quality.

ery important if true" said the president of the Carnegie ation some years ago to these intimations put forward as an ent for their encouragement. "Very important and true" only dignified retort. I do not wish to say that the devotees eontology are creatures of a superior order of intellect but not refrain from the expression that while they are dealing r in cosmic magnitudes nor the sublimated calculus, they hosen to serve at a high altar.

must be prepared now, with armies returning from abroad ned to the applications of science and armies at home ever ning these applications, for an intense magnification of its rial and commercial cogency. It seems quite likely that science e in danger of comprehension only in such terms as are pro- e of wealth. And as if this were not enough of a misbranding ence to correct, there lies a reproach upon science, led like a n away from its paths of rectitude into the maddening purlieus ischievous war.

ve recently read a passage from a published Sigma Xi address ich the author introduced his effective arguments and his ual attitude in this phrase:

ut to an engineer accustomed by training and habit to look ence and scientific laws as valuable only when capable of ation," etc. Here we diverge. Nature's fundamental laws ot be applied. They apply themselves; they govern without nt. If we read them aright then we ensure happiness and ss in adjusting ourselves to them. We are not called on to e science and scientific laws; nor is it competent to declare a valuable" in accordance with standards we set up. The law God, the standard of man. Over against the passage cited let it one emanating from a practical geologist whose career has marked by eminent attainment. The comment is on broad of geological science, all the more applicable to us because of

pplied geology is of such inestimable value to mankind that ady needs no stimulus, but pure geology is often, and now than ever, forgotten in the wild scramble for material results; et it is the basis on which all benefits to mankind from applied gy have been derived. During the war many geologists have their services in one way or another entirely to the country esearch departments have been largely depleted of workers.

With the termination of the war some of these research work
may return to their old pursuits, but many have been permanen
weaned away by mere worldly ambitions in applied geology. T
limit of elasticity has been strained; the rebound will not be co
plete. These ambitions, however, can not be realized unless t
trend of discoveries of new truths in the Earth's secrets can
maintained. A house can not be built to a height greater than t
foundation will support. I believe now, more than ever, the wo
is in need of work in pure geologic research."

Our contention that the principles which it rests with our scie
to enunciate afford the key to many sociological enigmas, is no
phantasy; and their application to the personal conduct of our o
lives must of necessity be productive of correct physical and spiritu
adjustments. And as I am fortifying my plea with the wisdom
other men, I here quote the expression of one to whose words
geologists attend with deference and whose vision has all the initiat
of a spiral nebula.

"Nothing could be more grateful to me than your strong ad
cacy of the study of the life record as a source of guidance in soc
logical, political and other problems of the human race. I ha
been trying to urge this for years."

In an address which I had the honor to give before the Geologi
Society two years ago I laid much weight upon the eventual cont
of the minority whenever that minority was strong at the head;
much emphasis indeed, that when the address was printed at t
expense of the taxpayers of New York it was gravely questio
in public whether this was a proper argument to promulgate a
time when we had just been assured that our principal pres
business was to make the world safe for democracy. But o
reasoning in this matter is not dependent on analogy; out of o
own demonstrations we can cite the proof in its fulness and
constant reiteration in the history of the earth. Today one-h
the world has broken loose into a mad and disordered su
An undisciplined and untaught horde have got the bit
their teeth and are running wild. Is this the thing we start
out to accomplish, this the kind of democracy we went out to ma
the world safe for? Were not the law, which we have brought o
of proven effectiveness through all things; had it not its foundati
in the eternal purposes of Nature, we might look with extre
apprehension upon the tempestuous and uncomprehending outbur
of the world's new so-called democracies, where malignity, ignora
and ambition conspire to unhorse responsible authority. T

racy that recognizes in ignorance its greatest menace, that
r safeguards the suffrage and honors the competent individual
us has been made safe for the world, will emerge triumphant
e world will in truth be safe for it.

signers of our immortal Declaration of Independence are
accused of audacity and mendacity when they put their names
proposition that all men are created free and equal. No
sentence in that charter of our liberties has evoked more
ige. But that condition seems to be the heritage of Nature.
ot the individuals of all the ages born free within the physical
ions of the class to which they pertain or the stage of physical
ion they have reached? And are they not, under normal con-
, equal physically and before the world into which they have
Equally they are dependent on, armored and equipped by
eritage, blue eyes and black eyes alike. With present valua-
factors of heredity and variation there is but little reservation
reply we must make to these questions. Men are, by the
l and immutable laws of paleontology, free and equal. We
say that they have been born to an equality of opportunity
es our Declaration of Independence advance any such intima-
That is a hypothetical condition which Nature does not under-
o supply. Blue eyes and black eyes do not look out on the
opportunity; if they did and if Nature's organic creations were
o such equality of opportunity there could have resulted only
ty and uniformity of result. In other words, equality of oppor-
in paleontology and in human history would mean a world
with the chief factors of evolution eliminated; indeed another
than this of ours in whose scheme there could be little place
e higher expressions of life. If there had been equality of
unity through the ages of paleontologic history there would
men in the world today. The state needs guidance in wisdom
dealing with the effort to create equality of opportunity for
izens. Such a state presents no attractions to me and I know
not be called upon to live in it.

a recent letter addressed to the members of the geology and
ntology committee of the National Research Council I wrote
agraph which I trust you will allow me to repeat here:

ill be time for us, as the clashing of arms dies away, to ask ourselves if
ching of geology by lecture or by pen has been sufficiently imbued with
l and spiritual influences which the science can so freely impart. He
acher only after the German model who fails or does not seek to enforce
adest bearings of his teachings and I trust that, in our intimate relations,

you will be sufficiently indulgent to permit me this expression: That, to the lar number of our students, these applications of the science are of far higher mom than the mere increase of their store of information.

Without loss of proper dignity or curtailment of accuracy and surely wi no surrender of respect for the theme, nor with imputation of preaching, t higher and fuller meanings of the science can be kept in sight and its influe be elevated in the thought of men.

Commenting on this an accomplished paleontologist has said th he feared such applications of doctrine except by men of protracte and intensive training and of judgment refined by clear perceptio I hold with him; but I believe too that no teaching of our scien reasonably derived, even if presented in a half light, will not le upward rather than down.

These are but a few thoughts out of many. I am compelled t make them few. But the theme is all-embracing. The recogniti of its philosophy, coextensive with the phenomena of life, is momentous importance to the new order. It is the lamp unto o feet and the light unto our path. The majesty of its promise philosophy reaching from the heights to the depths, a field of la fascinating in its details and uplifting in its reactions, ought draw to itself a body of serious-minded men and women who wou not sow their seed among thorns where the cares of this world a the deceitfulness of riches and the lusts of other things enter in make their labors unsatisfying.

NEW PALEOZOIC CRUSTACEANS

BY JOHN M. CLARKE

I

BUNAIA — A NEW MEROSTOME CRUSTACEAN FROM THE NEW YORK SILURIAN WATERLIMES

; was to be expected that the Salina formation, above and below horizon of the salt, would eventually afford evidence of the exist- e of the crustacean Bunodes or something closely allied to it. he Pittsford and Vernon shales of the lower part of the formation e already afforded the genus Pseudoniscus in two species r o o s e v e l t i Clarke and P. c l a r k e i Ruedemann) and e intimate a combination which is highly suggestive of the ypterid-bearing Silurian beds of Oesel, to which the genus odes has been thus far restricted.

he fossils now before us present certain characters very sug- ive of Bunodes and, it may be added, also of Hemiaspis, which Scottish crustacean of the same geological age. The resemblance ween these European crustaceans and the American species is, general lines, so obvious that their close relationship is clearly icated, but so far as we understand the new form it is materially erent in some structures, and adds some quite important details this group.

n the absence of very definite knowledge of the ventral structure he group with which these creatures have been associated in sification, they have been provisionally brought together with ers under the order name Synxiphosura[1] with the general subdi- ons (1) Aglaspina and (2) Bunodomorpha, the latter of these bining the following genera: Neolimulus (Silurian, Scotland); odes (Silurian, Island of Oesel); Hemiaspis (Silurian, Scotland); odella (Silurian, New Brunswick); Pseudoniscus (Silurian, nd of Oesel, New York). Of these, only two genera, Bunodes Hemiaspis, come into present comparison.

Bunodes, according to the descriptions by Eichwald, Schmidt and szkowski (who termed the fossil Exapinurus) and most recently

[1] Clarke, in Zittel-Eastman's Paleontology, p. 775.

by Patten (The Vertebrates and Their Kin) is a creature 2 to 3 inches long, with a short semicircular head, a broad thorax or mesosoma of six segments, followed by three narrow segments of the postabdomen with a long single telson spine. The head is marked by five curved radial furrows diverging on each side from the central subtriangular glabellar elevation; and these divide the surface into corresponding radial ridges. Doctor Patten has called attention to the retention of this primitive structure in the Limulus embryo, a fact which certainly seems to bespeak the direct descent of the latter from this ancient primitive merostome.

The New York fossil, which is here designated by the generic name Bunaia, is like Bunodes in these cephalic structures. Though of very much smaller habit, the carapace shows on the upper surface the same arrangement of parts and on the underside this pentameral division is clearly accompanied by remains of the five pairs of legs, the mouth orifice and, as it seems, the chelate first legs folded down close alongside the mouth.

We illustrate here in connection with these features a head of Bunodes lunula, the Oesel species, showing a similar arrangement of the five pairs of legs and in addition what appear to be the lateral thickenings of the glabellar ridges. This is a State Museum specimen from which the very thin epidermal film has been removed. Further, the head shield of Bunaia is progressed over that of Bunodes in its thickened margins and extended cheek spines. Patten believed that antennae were present in Bunodes and so restored it, but we find no evidence of these structures in Bunaia.

In our specimens the chief difference of Bunaia from Bunodes is in the structure of the abdomen. In the latter there are six broad segments followed behind by three narrow ones. In Bunaia this structure appears to be somewhat different. The cephalon or head shield is followed behind by narrow segments of which seven or eight can be counted, with possibly one missing. These seem to be of somewhat unequal length and to be longitudinally ridged but without lateral flanges. Our knowledge of this structure is restricted to a single example and is subject to qualification. In one of the three specimens there is a broad, detached, smooth spine lying alongside the head, which may have been the telson, though apparently pretty large for the species.

The size is as follows: width of carapace 8 mm; estimated total length of animal, inclusive of telson, 23 mm.

Remarks. The distinctions we have pointed out are sufficient to justify the generic division Bunaia, but there are still some points

ding the abdominal structure awaiting verification. I have ated this species to Dr Henry Woodward, founder and now tus editor of the Geological Magazine, whose labors among the arthropods have been long continued and most fruitful. Every nt of these creatures acknowledges his indebtedness to Doctor lward's honorable and helpful service and it is a pleasure to ate to his name and his work, this ancient denizen of New York. e specimens of Bunaia woodwardi are from the e waterlime of East Buffalo, N. Y.

Plate 1

133

Bunaia woodwardi

Fig. 1 A weathered exterior of a head shield showing the triangular central area or " glabella " and the five pairs of lateral lobes crenulating the surface and corresponding to the legs beneath. x 8

Fig. 2 The interior of a head shield with five pairs of radial appendages and evidently a 6th pair at the central mouth. The light colored lines on the right hand radial areas are elevated linear ridges which appear to be parts of the appendages themselves, and it is thought that the broad dark areas may include both legs and gills. x 8

Fig. 3 A crushed and defaced head shield with a postabdomen of ridged segments. x 8

Fig. 4 A telson spine which lies close to the specimen fig. 1 and it is thought may belong to this species. x 8

All the foregoing are from the Bertie waterlime (Silurian) at the East Buffalo quarries.

Bunodes lunula

Fig. 5 An exfoliated carapace from the Silurian of the Island of Oesel, showing the broad dark bands left by the six pairs of cephalic appendages and also the central divergent ridges which seem to be the interior projections of the ridges of the " glabella." x 3

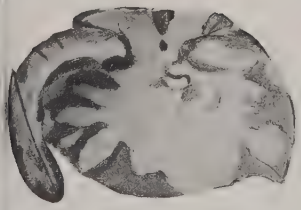
N. Y. State Mus. Bul. 219–20

Plate 1

1

5

2



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3

H. S. Barkentin, del.

II

CRUSTACEA FROM THE PERMIAN OF SÃO PAULO, BRAZIL

rough the courtesy of Mr J. Pacheco of the Geographical and ogical Commission of São Paulo, I have received a series of new aceans from the locality of Guarehy in the state of São Paulo, rocks of which are determined as of Permian age. I am not e of the collateral stratigraphic evidence upon which this deter- tion has been based but all the evidence shown by the rock mens sent and independently of the crustacean remains, would to corroborate this determination of their age. These speci- s are thin slabs of dark, chocolate-colored magnesian limestone ying considerable chert scattered through them in nodules and , together with some noticeable quantity of pyrite. On the ces of these slabs carapaces and other crustacean parts have flattened out and some of the fragments of rock are composed ch debris. I have been asked by Mr Pacheco to identify and ribe these fossils.

find on solution of the matrix that the rock occasionally contains es of other organic remains replaced in silica, and among these parts of a Bellerophon and a Loxonema of types which might y be regarded as appropriate to the Permian horizon. A single imen of the crustacean, replaced with chert, has given the true or oximate contour of the carapace, and this has helped very erially to illuminate the original form and probable relationship he species. In addition to this predominating and abundant erial are other remains occurring in a drill core of soft gray shale n from the same locality; the latter crustaceans are of a different acter than the others.

Paulocaris pachecoi sp. n.

hese carapaces vary in size from 15 to 20 mm in axial length and heir flattened form have a semicircular or ungulate shape, notched h back and front. At the front the axial line is extended into a rply angular and erect rostrum from the base of which an incurved passes on each side and terminates in a spinule, so that the front rgin bears a center spine or rostrum and two lateral spines or ules. The rear margin of the shield is more broadly incurved utline and thickened by an arched segment. In the axial line just back of the central point of the shield is a short, sharp and

thickened ridge often curiously replaced and hardened by chert and in several observed instances this central ridge is out of alinement lying either at one side or the other of the middle line and occasionally askew. Back of the anterior rostral marginal curves and close upon them lie broadly rounded nodal elevations from which low grooves converge backward. The lateral margins of the shield are thickened like whipcord and the surface of the carapaces, when well preserved, shows a fine papillose or linear ornamentation quite peculiar to the species, in the sense that it is not like the linear incised or elevated inosculating ornament which usually marks the fossil Phyllocarids.

The very singular feature of this carapace is the mode of preservation of the nuchal margin or ring. On the surfaces of the slabs this ring is exposed frequently in detached condition and it is obvious that in its original state it was greatly thickened so as to strengthen and assure convexity to the head shield. The single convex specimen of the carapaces shows that the form in its original state was elevated and broadly rounded, carrying the curvature indicated by the detached rings found in the rock, and that the carapace was without any evidence of median suture or independent rostrum.

The presence of antennae is indicated in one very obvious specimen and by scattered fragments of others.

As to the thorax and abdomen, little can be said. There are remains of segments which carry at each extremity a jointed appendage of triangular form. So far as the evidence goes they seem to be attached to the segments as lateral, terminal pieces and not to have functioned as exopodites. These triangular plates lie scattered about in considerable numbers and it seems from certain segmental structures that they are themselves related to the segmental composition. Of the tail and telson parts nothing definite is now known.

Paulocaris was a crustacean of decapod affinities. However much the flattened carapaces suggest alliance to such Phyllocarids as Hymenocaris and the Ceratiocaridae, the solid carapace, the antennae and segments are too clearly decapodan, whatever the station of the genus may prove to be within this order.

The other species, represented in the drill core and preserved in clay shale is in two specimens, both together too fragmentary to serve much more than to indicate an interesting species of the ancient shrimps known as Palaeocaris and Gampsonyx. In both these specimens the head is missing. All that remain are portions of the thorax and abdomen. The species is doubtless distinct from any recorded and subject to better knowledge may be designated as

Gampsonyx brasilicus sp. n.

e head is absent. The thoracic somites are numerous and
ır to be from eight and more, very narrow and bandlike, all the
rior members bearing a median pustule. The abdomen consists
broader somites with lateral triangular posteriorly directed
sions, those on the ultimate joint being distinctly leaf-shaped.
elson is narrow and the stylets in two pairs, the outer being the
r.

EXPLANATION OF PLATES

Plate A

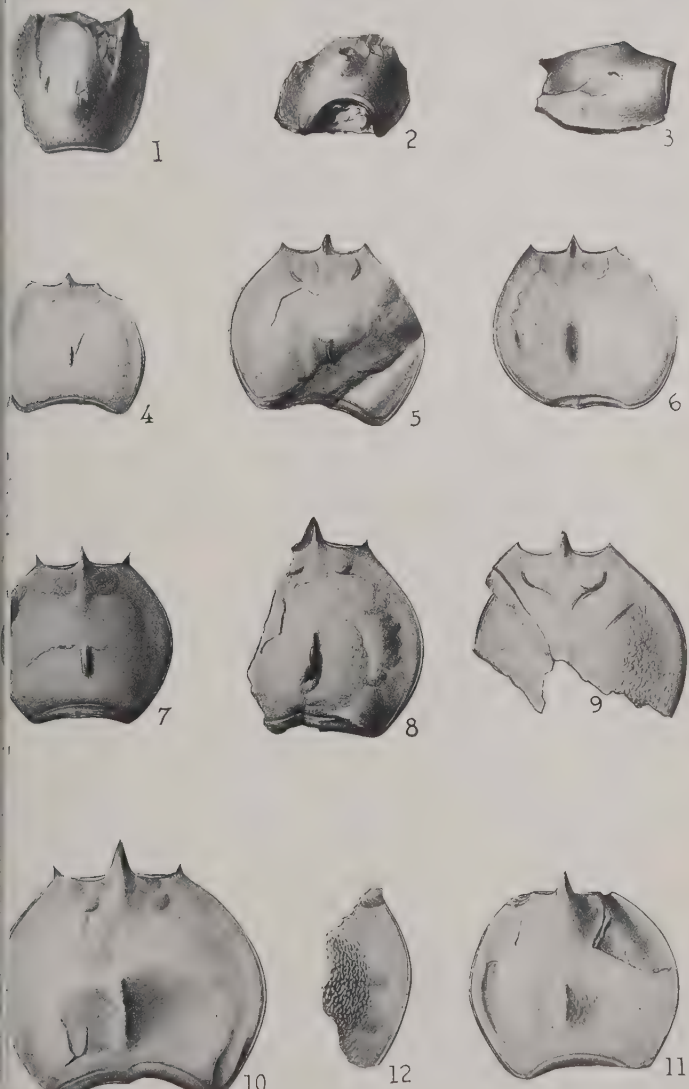
139

Paulocaris pachecoi

Figs. 1, 2, 3 An uncrushed carapace extracted from a pyritou nodule and showing the normal convexity. Natural size.

Figs. 4–11 Flattened carapaces, all enlarged to 2 diameters an showing various structural features. Attention is directed especiall to the indications of frontal or ocular nodes, to the rostral spine an the two lateral frontal spines and to the postmedian ridge which i usually, for some reason, hardened and sometimes distorted.

Fig. 12 A portion of a carapace which shows the sculpture o the lateral surface. x 2



J. S. Barkentin, del.

Plate B

Paulocaris pachecoi

Fig. 1 A portion of an abdomen which is provisionally referred to this species. This specimen indicates four segments and the terminal joints on each. x 5

Fig. 2 A portion of an appendage showing the terminal joint. x 2

Fig. 3 A single abdominal segment in which the terminal joints, if present, are apparently concealed. x 2

Figs. 4, 5 Triangular plates which are probably terminal joints of the abdominal segments. x 3

Fig. 6 A fragment of rock showing the stiffened and convex nuchal edges of the carapace. x 2

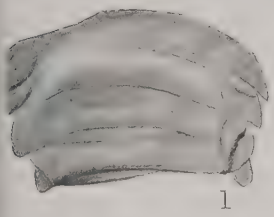
Fig. 7 A similar specimen. x 1

These seem to indicate that in the maceration of the carapace this heavy and stiffened ring became detached.

Fig. 8 Two carapaces apparently in casual juxtaposition, with remains of a long antenna preserved. x 2

Gampsonyx brazilicus

Figs. 9, 10 Both of these segments are from drill cores and show parts of the abdomen, postabdomen and telson. Both are enlarged 2 diameters.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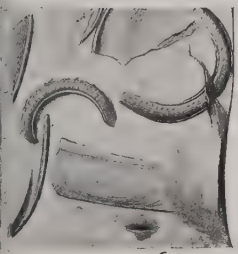
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. S. Barkentin, del.

MSTRONGIA, A NEW GENUS OF DEVONIAN GLASS SPONGES

BY JOHN M. CLARKE

n recently discussing the Devonian glass sponges, I described under name of Ceratodictya oryx (N. Y. State Mus. . 196, p. 180, pl. 2, 1918) a slim and strongly annulated form, ressing at the time some hesitation in referring these short and ple twigs to the genus Ceratodictya which had been created ue twenty years ago[1] for the reception of much larger and more ularly developed reticula. Our knowledge of this sponge has n enlarged in a very interesting way through the acquisition of ab of Chemung sandstone recently taken from the original local- of the species, on the broad surface of which apparently two in- iduals of the sponge are laid out in impression, in what would n to be approximately complete extent. Whilet he structure the branches indicate its specific identity with C. oryx, its raordinary branching form and accessory structures show that s sponge has nothing to do generally with Ceratodictya.

n the figure here presented of this slab the relief is given rather n the natural impression, the picture being made from a cast of original. It will be seen that we have here to deal with a diffusely- nched sponge whose form and direction of branching is approxi- tely determinable from the form of the annulations. These have normal expression of ensheathing rings with their steeper slopes ected backward or toward the root. This index is not easy to ow in all parts as occasionally the annulations show little differ- e in upper and lower curves. On this slab there seems to be more n one colony represented, possibly three in all; but one is con- cuously shown, displays the form of structure at the joints and licates that branching is very diffuse. The surface of these annu- ed branches shows fine striations on the sandstone matrix in the erannular spaces, but little can be seen of spicular tufts projecting m the annuli.

Other structures are indicated: Several of the branches show minal sheaths or smooth conical extensions running out into a nt truncated apex. Two or three of these are in place and several

[1] Hall and Clarke, Dictyospongidae, p.117 (N. Y. State Mus. Mem. 2, 1898).

others are scattered over the surface of the slab. They suggest th nonreticulate tuft or undifferentiated felt of spicules which common enough at the root of many living hexactinellids. Th position of these, however, is obviously not basal. Position, mod of branching and some other features indicate that these sheaths c tufts are terminal to the branches and represent compacted growt ends. This consideration, not very easy to substantiate perhap among living sponges, is helped by the fact that the slab shows prac tically as many such sheaths as there are branches. Some are i place and some apparently detached but there are many more tha the number of sponges would require as root-ends.

In addition to these structures the slab shows some flat concentri disks which would seem to be in all probability a part of these organ isms. These disks are depressed at the center and their concentr cally-lined surface is like that of the epithecal base of a Chaetete or Pleurodictyum. Such circular bases are not, however, foreign t the living glass sponges and the association makes it probable tha these disks have served such a function here.

In seeking comparison among the living Hexactinellids with thi singular branching Devonian sponge we find a suggestive specie in the Sclerothamnus clausi (Marshall) as depicte in Schulze's *Report on the Hexactinellida* of the Challenge Expedition (p. 337, pl. 98). To institute more closely this com parison between two branching sponges the Challenger species i here copied. Here the annular tufts appear to be not alway circular but at times continuous and spiral though the branchin is unlike that of the Devonian species, but so seldom doe branching occur that the two forms are comparable on that basi alone.

As we can no longer associate this species with the genus Cerato spongia it is now proposed to term this sponge *Armstrongia,* i recognition of the intelligent interest taken in the collection of thes Devonian sponges, by Mr E. J. Armstrong of Erie, Pa., and the notabl additions to our knowledge of them which his specimens have con tributed. This slab, which was found loose, is from the upper bed of the Chemung group, 9 miles south of Erie, Pa., and carries on it back abundant specimens of a large Liorhynchus, probably L mesocostalis.

Armstrongia Oryx

Fig. 1 Natural size drawing of a cast of the original slab showing the full extent of the specimen. The original is preserved as a natural mold.

Upper beds of the Chemung group, 9 miles south of Erie, Pa.

Sclerothamnus Clausi (Marshall)

Fig. 2 Drawings of living specimen taken from the "Report on the Hexactinellida of the Challenger Expedition."

E MICROSCOPIC FAUNA OF THE BONAVENTURE CONGLOMERATE

he Bonaventure conglomerate of the northeastern Atlantic coast ns to be, as I have often stated, an equivalent and contemporary he Catskill formation of New York in the sense that in both the osition of this deposit began before the close of Devonian time continued over the boundary line as marked in the marine cession into the early Carboniferous. Both seem to be also out- sh gravels and sands.

his age determination could perhaps not be clearly made on the dence of either formation. James Hall believed this to be the erpretation of the Catskill formation in New York; the obvious d elevation during the late Devonian of Gaspé with the formation land ice corroborates this construction and both cases are, in a oad way, supported by the recognized time value of the Old Red dstone in Britain. The Bonaventure formation is a conglomerate d sandstone lying flat on the almost vertical edges of the early vonian, Silurian, Ordovician and Cambrian strata and its pebbles e recognizable fragments from those formations with no incon- lerable mixture of crystalline blocks from the Gaspé or Laurentian ghlands.

One often finds in the conglomerate great coral heads of Halysites m the Silurian whose outcrops are known, and the other fossil- rous pebbles and boulders are a source of constant interest to the adent of fossils. The leading constituent of some of the Bonaven- re beds, however, is flint in the form of jaspers and cherts. For a ng time I have suspected these cherts of carrying a microscopic una and am very glad now to present the following evidence of it. ut of a considerable number of sections from these chert pebbles ly six have shown the fauna herewith described by Dr Rufus M. agg. These few slices of rock not covering in total 3 square inches surface, have revealed over forty species of Foraminifera, with idences of Sponges and Radiolaria, and from this one may gain me idea as to the not inconsiderable abundance of these creatures the rocks out of which these pebbles were washed by the torrents the late Devonian.

Doctor Bagg has been disposed to conclude from the very interest- g evidence he has amassed, that these cherts are of Cambrian or

Ordovician age. Of this it may be remarked as a field observa
that the Ordovician limestones cover a vast area in the interi
the Gaspé peninsula but nearly everywhere they are or seem t
continuous with the Silurian and the demarkation of the two fo
tions is not yet clear; while the Ordovician shales are similarly
plicated with the Cambrian shales and these, also, have not
been clearly defined and probably can not be till they have had s
such refined study as has been given to the Ordovician-Camb
(Hudson River) shale beds of New York. It is, however, t
shales that seem to be the home of the cherts now under study
it is fair to give acceptance to either judgment as to the age of t
Foraminifera — that they are with apparently like probability ei
Ordovician or Cambrian. If Doctor Bagg finds internal evid
proving their Ordovician age there is every reason, aside from t
for following him.

The identifications of species and genera here given are b
entirely upon shell sections which do not permit refined comparis
and as a result of this enforced procedure a conservative treatme
necessitated. To aid the comprehension of these sections, the nat
full form of species allied to or, for sake of a name identified with
section, is in most cases given on the plates of illustrations; and
figures thus introduced have been largely taken from English writ
on Mesozoic, Tertiary and Recent Foraminifera. The real pur
of this study is to show the presence and abundance of the creat
in these ancient rocks.

Doctor Bagg has worked out this problem with skill and satis
tion and I am glad to have again, after the lapse of many ye
brought him into touch with the work of the New York State Muse
In the performance of this work I have also had the help of
associate, Prof. George H. Hudson, whose exceptional skill in mi
scopic photography and discriminating scientific knowledge
made these diminutive organisms visible.

JOHN M. CLARK

FORAMINIFERA OF THE BONAVENTURE CHERTS OF GASPÉ

BY RUFUS MATHER BAGG

material here studied from the Bonaventure formation consists six thin rock sections of cherts sent to the writer by Dr John arke. Accompanying these thin sections are a number of nt microphotographs made by Prof. George H. Hudson of burg. We acknowledge our indebtedness to Doctor Clarke as furnished some necessary literature and also to Professor n, whose wonderful skill in photomicrography has assisted us identification of species which might otherwise have been oked.

purpose of this investigation has been not only to determine istence of this fauna but if possible, the geologic age of these or impure flints, since they naturally are derived from an epoch than the conglomerate in which they are found. The enture formation is regarded by Doctor Clarke as largely a deposit of late Devonian or early Carboniferous time. The specimens are all filled with Foraminifera, many of which are fect as when originally deposited in the ooze of a paleozoic and the silification of their tests was slow enough to preserve chamber and septal division. We have identified in these six lides seventeen genera and forty-five species belonging to many but it is only fair to state that we have by no means exhausted naterial. This is because the identification of fossil Foramin cross section alone is exceedingly difficult. All the study le after careful and searching investigation fails to give one ence of the certainty of every species determined. This is ally true of the rotaline forms where tangential sections of nt genera are much alike, as, for example, Truncatulina and alina or Pulvinulina; or Verneuilina and Bulimina. This matical factor must be clearly borne in mind and accounts for ilure to describe additional species which we know to exist in herts but which without further material it is hazardous to fy.

Evidence from Sponges

ere are fortunately a number of other organisms present in the beside Foraminifera. The simplest of these consist of uniaxial etraxial sponge spicules which occur in some abundance on two

sections, less frequently on the others; but all of which indicate ian age. In one or two cases dermal spicules are grouped in a co base, yet so minute that the spicule with its rootlet measur 0.01 mm in length and the fragment in which it is embedde 0.03 mm in outside diameter.

These spicules belong to Lithistidae and are similar to th Anomalospongia reticulata Ulrich from the Cin horizon in Kentucky, but the latter are many times larger th specimens. They show below the prongs the widely div angle of about 110 degrees which pertains to the four-rayed This serves to separate these from six-rayed hexactinellid s whose cross sections also show three-rayed structure. These erous uniaxial and tetraxial spicules are quite typical of both and upper Silurian. The massive thick-walled, siliceous pa sponges belonging to the order Lithistidae occur from the Ca to the Recent but become more abundant in Silurian strata again in the Jura and Cretaceous. Some of these sponges ma furnished the silica in which the Foraminifera were embedde none of the full sponge masses remain. On slide 6 is a fine fra of a minute sponge with six tetraxial spicules of dermal cha but only five show the forking terminal. They project abo sarcode base 0.01 mm and are remarkable for their delicate str Only in one case did we detect a club-shaped spicule of tria shape and it is possible that this is a rhabdolith.[1] We have r literature to study fully these sponges but consider from the ev at hand that they are of Silurian age, perhaps Upper Silurian i cases. It is not improbable, however, that they come chiefl the upper Ordovician as sponges of this type range well throu entire Silurian period.

Evidence from Radiolaria

The second group of organisms represented on these sl Radiolaria. These are mostly fragments of coarsely pe spherical shells and in no case do we find complete forms which identification. The best example we discover is seen on s This radiolarian has a spherical test with elongated axial ray of which can easily be made out. These come out from th without enlargement, as in Lichnaspis and not very differen Acanthometra, the latter possessing twenty such spinous pro The spherical fragments resemble Cenosphaera macr

[1] The Microscopical Fauna of the Cretaceous of Minnesota, Woodw Thomas, Geol. Minn., v. 3, pt 1, 1895, p. 49, pl. E, fig. 2.

of Ordovician age. On slide 1, for example, a few circular
gs occur in a colloidal base, but not enough is preserved to
ine whether they belong to the Spumellarian or Nasselarian

olaria belong to very deep water; but they occur to a limited
in all oceans where the salinity is not too low, in shallow as
deep water, so that their presence in these cherts does not
an abyss of 2 miles depth to account for their occurrence.
never had an extensive development, however, until Miocene
but their skeletons have been preserved in the oldest fossil-
horizons. We believe the radiolarian in the chert was of
al form and that the uneven distribution and unequal spacing
large pores (some 0.025 mm in diameter) is due to tangential
of a sphere. As far as this unsatisfactory evidence goes it
to indicate Lower Silurian age.

Evidence from Bryozoa

eight-lobed star-shaped fragment occurs on slide 6 (poorly
e 1), which does not belong to the Foraminifera; but we
esents the zooecia of a bryozoan-like Arthroclema cut in trans-
section.[1] Both Arthroclema and Helopora would show such
structure but we do not know whether an eight-lobed form
be obtained from these. From illustrations given, the number
s does not seem to be constant, for some show six and others
of such zooecial segmentations. One or two additional bryo
ke forms occur. On slide 4 occurs a bryozoan section which
to me to be related to Homotrypa similis Foord
in the Cambro-Silurian rocks of Canada. It is so cut that no
can be had which brings out its exact structure. In addition
ve a few surface apertures in fragmentary masses present, but
case can we determine the species to which these Bryozoa
. We believe, however, that such evidence as can be obtained
a further study of these forms will result in indicating their
Silurian age.

Evidence from Additional Organisms

eral problematical specimens occur on the slides which ought
included in this survey, even though it is impossible to
nine their character. Some of these may be diatoms like
al, lenticular specimen seen on slide 6 and many others, but we

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ch, Silurian Bryozoa, Geol. Minn., v. 3, pt 1, 1895, pl. II, figs. 13-15, and
28 and 29.

do not think diatoms are at all frequent or characteristic
material and are inclined to doubt their presence for several re
As far as we know, when diatoms exist in any material, it is
possible to get many types and abundant examples of various
if not genera and none of this evidence occurs. One cross sect
slide 4 resembles a crinoid stem; but we know of none which
measure 0.16 mm in diameter, and in any case it ought to be
metrical, which this is not. Another prismatic, oval and very
fossil occurs on slide 4 which may also be a crinoid, but we do n
how it can be such and possess so narrow and elongate a form

Another problematical, perhaps spongelike, mass is seen on
2 and still another very large four-segmented, thick-walled spe
on slide 4, which looks as though it might be an arenaceous fora
feran, like Reophrax or Haplophragmium. The chambers a
connected, however, the openings are irregular and do not se
be present toward the smaller end and the form is not com
Moreover, the septal divisions faintly shown are oblique.

No satisfactory evidence can be obtained as to the age repres
by the miscellaneous organisms referred to above; but we do no
justified in ignoring them and mentioning only material w
determine.

Evidence from Foraminifera

The evidence obtained from the very large number of Forami
occurring in the chert is both negative and positive. Fro
negative side we should note that no Fusulina or Endothyra
nor do any of the late typical Carboniferous species, save N
saria radicula, become abundant, and this type is ju
representative of the Silurian or Cambrian as it is of the Carbonif

Taken as a whole the fauna is more like the Trias, for w
many species identical with those of the Trias of Bakony des
by Vadász and referred to in our bibliography. The occurre
so many Globigerinae and Textulariae is not surprising as these g
are among the oldest known, but it is striking that we find s
large development of the genus Virgulina, and Bolivina as well.
do not know of any such discovery in formations so primitive as
must be, and did not suppose that Virgulina occurred in Pal
horizons. Pulvinulina and Rotalia are both highly organized g
the latter often showing a complete interseptal canal system su
exists in Nummulina and Polystomella; but both these have
recorded from the Cambrian of Russia and described by Ehre
from blue clay which he considered Silurian, but which is now k
to be of Lower Cambrian age. There is, consequently, no r

he fossils here identified can not belong to the Cambrian era. are furthermore several Globigerinae which appear to be iden- with the forms described by Matthew from the Middle Cam- of Hanford Brook, St Martin's, N. B.

the other hand, we find numerous Lagenae which are well n from the Silurian and have been described in several reports. uilina has been recognized from the Cambrian and it is not sible that some of the Virgulina or Bulimina — like types we identified belong to this genus, but this is not likely. We e, all things considered, that these cherts came from late rian and early Ordovician formations, with the greater proba- that they are Ordovician. We might argue: if they are so y developed and in such profusion why not place them in the nian. In the first place, we do not find many Foraminifera in era and no typical Devonian species like Lagenulina or Fusulina nown among this group. Many of the Devonian formations ow thought to have been either terrestrial, wind-blown sands or and brackish water deposits; and in some cases, like the horn- of the Corniferous, fresh water desmids occur.

r belief is, therefore, that, with all evidence considered both Foraminifera and other organisms, these cherts came most r from deposits of Ordovician age. If from other evidence can be traced to Cambrian we would not be surprised, as cer- y many of the types we recognize are present in Cambrian forma- . The seas were of considerable depth and the Foraminifera sited far from land. The waters were clear and free from much genous material. These facts are shown in the very minute, abundant, Textulariae and Bolivinae, genera whose shells built of delicate hyaline calcareous material.

partial bibliography of the works most helpful in this study is n below.

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Outline Classification of the Foraminifera Identified in the Bo
venture Cherts

Subkingdom — Protozoa

Class — Rhizopoda
Order — Foraminifera (Reticularia)
Family V — Textulariidae
a Subfamily — Textulariinae:
Genus, Textularia..... 5 species
" Verneuilina..... 1 " ?
" Valvulina..... 1 (possibly 2)
b Subfamily — Bulimininae
Genus, Bulimina..... 2 species
" Virgulina..... 3 " possibly
" Bolivina..... 3 "
Family VII — Lagenidae
a Subfamily — Lageninae
Genus, Lagena..... 3 species
b Subfamily — Nodosariinae
Genus, Nodosaria..... 3 species
" Cristellaria, ?..... 2 " ?
c Subfamily — Polymorphininae
Genus, Polymorphina..... 3 species
Family VIII — Globigerinidae
Genus, Orbulina..... 3 species
" Globigerina..... 7 "
Family IX — Rotalidae
b Subfamily — Rotaliinae
Genus, Discorbina (Discorbis)..... 1 species
" Truncatulina..... 3 "
" Anomalina..... 1 "
" Pulvinulina..... 3 "
" Rotalia..... 1 "

DESCRIPTION OF SPECIES

Genus, TEXTULARIA Defrance

genus Textularia, in early writings often spelled Textilaria, arkably well represented in the Bonaventure cherts by at least pecies. Textularia globulosa Ehr. predominates n slide 5 constitutes the most frequent type of any Foraminifera nt. With the exception of Textularia trochus d'Orb., ecies of this genus are extremely minute and indicate the te calcareous and hyaline varieties suggesting rather deep- conditions. Between these tiny T. globulosa and T. hus lies an intermediate sized form T. gramen d'Orb., his is narrower and less coarsely constructed than most speci- belonging to this species.

tularia is one of the earliest types of Foraminifera to develop as been recognized in every geologic period from the lowest rian to the present. Professor Brady in his monograph on Carboniferous and Permian Foraminifera describes five species xtularia from those formations. We are not aware, however, many perfect types ever having been identified in Lower Paleo- trata such as we are studying; but our investigations only prove we have long suspected, that given favorable conditions for cation these primitive organisms will be found represented by genera in Cambro-Silurian eras.

Textularia gibbosa d'Orbigny

Plate 1, figures 1, *2a*, *b*

xtularia gibbosa d'Orbigny, 1826, Ann. Sci. Nat., 7: 262, no. 61
xtularia gibbosa Brady, 1876, Pal. Soc., vol. for 1876, p. 131, . X, fig. 36
xtularia gibbosa Jones, Pal. Soc., vol. for 1895, p. 152, pl. III, gs. 10–13, and pl. V, figs. 13, 14

e comparatively large, coarsely constructed Textularia seen on 1 belongs to a very different type of Textularia than the more non, delicate, globular chambered forms seen in all of these s. The cross section of one or two other few-chambered, ly enlarging, stout forms would give almost the same appear- when seen in thin section. This would also be true of the ate chambers of Gaudryina; but, because the distal segments cking in our specimen, whether it is irregular in these primordial bers or not can not be determined, and we believe the form is a

true Textularia of unusual dimensions. The width of the ultim segments measures 0.3 mm, but its length is unknown.

Textularia gibbosa is common as a Tertiary fossil and is in mediate between larger, longer and coarser T. agglutina and the delicate, elongate, multichambered T. globulo Good illustrations and descriptions are given by Brady in his Mo graph on Permian and Carboniferous Foraminifera. Bra specimens came from both Lower and Upper Carboniferous horiz of Scotland, Russia and Belgium.

Textularia globulosa Ehrenberg

Plate 1, figures 3, 4*a*, *b*, *c*

Textilaria globulosa Ehrenberg, 1838, Abhandl. Akad. Wiss. Be p. 135, pl. iv, fig. b (and others)

Textilaria globulosa Ehrenberg, 1854, Mikrogeologie, p. 21, pl. xxv, fig. I, *a*, *b*, and pl. xxiii, figs. 3–6, etc.

Textilaria globifera Reuss, 1860, Sitz. Akad. Wiss. Wien, v p. 23, p. 232, pl. xiii, figs. 7a, 8

Textularia globulosa Jones, 1895, Paleont. Soc., 19: 155, pl figs. 18, a-c

There are many very minute, few-chambered, Textulariae belo ing to this species present on every slide examined and they are esp ially abundant on slide 5. There are but four or five segme present in each series with thin, delicate walls separated by w marked and somewhat depressed sutures. Some sections show many as six in a series but the usual number seems to be fo In one cross section we find a form almost triserial, with two or th chambers lying midway over the biserial segments; but I th this is due to secondary filling as the chamber is not uniformly evenly modified and the triserial arrangement is not regular, would be the case were the species Gaudryina or Valvulina. T specimen is too minute to resemble the coarser Gaudryina ty Cross sections longitudinally measure from 0.09 to 0.12 mm in m slides, but they vary perhaps more than this if all sections were ca fully measured.

Textularia globulosa was not found on the Challen expedition and it does not seem to occur in existing oceans. is, however, recorded from the Cretaceous of Minnesota (Woodwa and we have identified it from the New Jersey Cretaceous. It rather singular that Brady did not report its presence in his Carbo ferous monograph as he identified so many Textulariae of that a

Textularia gramen d'Orbigny

Plate 1, figures 5, 6

Textularia gramen d'Orbigny, 1846, Foram. Foss. Vienne, p. 248, pl. xv, figs. 4–6

Textularia gramen d'Orbigny is typically a short, thick, few-chambered form closely related to T. hauerii and T. abbreviata. On slide 4 we find what appears to be a narrow form of this species but it is probably cut a little diagonally as one side is not very distinct. A better illustration but not complete, is found on slide 5 (X).

The segments of this form are less globose than in T. globulosa; and it is more coarsely constructed. It is best known as a Miocene fossil. In the Bonaventure cherts this species is rare, the most abundant form being T. globulosa Ehrenberg. The specimen represented on slide 4 measures 0.14 mm in length and the more typical specimen on slide 5 (X), but 0.08 mm.

Textularia pupa Reuss

Plate 1, figures 7, 8*a*, *b*

Textularia pupa Reuss 1860, Sitz. Akad. Wiss. Wien, p. 232, pl. 13, figs. 4, 5. (Textilaria)

On slide 3 occurs a cross section of a very minute textularian resembling T. globulosa in outline but with its segments less inflated and the ultimate chamber a little angular. The septa are more narrow, curving less than in globulosa, and the form corresponds to Textularia pupa Reuss from the Cretaceous of Westphalia. This species must be considered very closely related to the more abundant form T. globulosa but can be distinguished from this by its septa, greater proportional width and more flattened segments. The form on slide 3 consists of but four and three chambers in each series and measures but 0.10 mm in length and belongs to the delicate, delicate-walled textularian type which seems greatly to predominate in these cherts. In fact, we doubt whether any other Textulariae, save the T. gibbosa, of these cherts were originally built of anything but pure calcareous matter, suggesting rather deep oceans free from shore sediments. A less typical specimen is found on slide 5.

Textularia trochus d'Orbigny

Plate 1, figures 9, 10*a*, *b*

Textularia trochus d'Orbigny, 1840, Mem. Soc. Geol. France, 45, pl. IV, figs. 25, 26

Textularia trochus Jones, Parker & Brady, 1865, Pal. Soc., 19: 15 pl. iii, figs. 17, 18

Textularia trochus Vadász, 1910, Triasforam. aus dem Bakony p. 14, pl. I, fig. 5 and fig. 2 in text

The transverse section shown by Vadász (loc. cit.) to illustrate th arrangement of the segments could easily be used for a drawing o our specimen of this large Textularia found on slide 5 (X).

The shell is short, stoutly built and of coarse construction, ver different from the many minute delicate and beautiful Textulari globulosa found in these cherts so abundantly. The segment offset somewhat alternately as if not truly apposed, the hollo cavity within dovetailing above and below each chamber. Th sutures are almost flush and the chambers are narrow and horizontal not arched as in many other Textulariae. This is one of the mos symmetrical of all the genus and widens rapidly but very symmetri cally from a rather blunt base which in some forms draws down t a rather sharp extremity. There are but few segments, apparentl about seven or eight in our specimen in each series, but those at th distal end are indistinct. The length of this specimen measure 0.35 mm. The oral end is centrally depressed and the entire for may lack another chamber, but probably does not as the sectio seems pretty evenly cut. The walls are very thick except on th border and along the central portion of the shell.

This form must have been finely arenaceous, as it has such a coarse massive structure and is so very different from the Textulari globulosa Ehr. with its hyaline appearance. The Trias form figured by Vadász were twice the size of this chert specimen an measured in length 0.60 mm. This form occurs in the Cretaceou rather frequently as well as in many Tertiary deposits. Jone reports the species as having wide distribution in existing oceans i shallow waters, especially among coral sands.

There are three Textulariae which are rather closely allied t Textularia trochus, namely T. turris, T. conica and T. barretii, but the last is much more elongated wit labyrinthic interior, T. turris is more coarsely constructed a well as more elongate, while T. conica is very short, more or les compressed and the walls are thin. There is also some difference i

shape of the ultimate chambers in all these related conical Textu-
e, but not a sufficient difference to distinguish each species.
xisting types T. trochus measures a distance across almost
reat as the length of the shell, but this does not hold true for all
l forms. In our example the width of the anterior end is 0.23,
gainst a length of 0.35 mm.

Genus VALVULINA d'Orbigny

he genus Valvulina has hitherto been supposed to be limited
he Carboniferous and succeeding horizons. Prof. H. B. Brady
tified many forms of this triserial foraminiferan in the Carboni-
us of Europe; Mr Chapman in the Portland Oolite (Stramberg
stone); and it is an unusual type in existing oceans. On slide 1
very large, almost circular, thick-walled foraminiferan which I
k must belong to this genus but we can not of course identify the
ies as we have no vertical section of the same fossil.

Valvulina sp.

Plate 1, figures 11 and 12 (another species)

he form identified doubtfully as Valvulina (slide 1; see figure 11)
ery large, measuring 0.42 mm across its nearly circular test. There
but five transverse segments present, and each is separated by
vy, thick, arched septa becoming still more massive at the peri-
ry. We know of no rotaline form so large and massive which
ld furnish so circular a section. Valvulina paleotro-
u s (Ehrenberg) described by Professor Brady in his Carboniferous
nograph would closely approximate this type. Valvulina
lomorphinoides Reuss would show the same number of
ments, but the figured form of Reuss is not round and its margin
slightly limbate, as in figure 12. We do not seem to find very
ny species identical with the European Carboniferous; and such
es as would most certainly occur if we had Carboniferous Foram-
era, like Fusulina and Endothyra, are entirely lacking. However,
provisionally place this specimen under Valvulina and also the
cimen shown in figure 12, but they can not be further identified
til other sections reveal the lateral form. It is strange that if this
us were common we do not find other types cut so that they reveal
true character. Possible small types are seen also on slides 4
d 5.

Genus VERNEUILINA d'Orbigny

Verneuilina is a triserial foraminiferan with textularian apertur It is often triangular in outline with edges sharp, but its test is coarse constructed in recent forms as in the larger arenaceous genera. The are comparatively few segments, arched above and resembli Textularia in the arrangement of each. This genus has been report (Ehrenberg) from the Lower Cambrian of Russia; but it is best know as a Cretaceous and Tertiary fossil, and a small number of forms exi today. We are not positive that this genus is present in the Bon venture chert, but either the transverse sections assigned to th genus are Verneuilina or they belong to Bulimina, which would sho a similar outline. The size of the silicified test would not be sufficie to separate the two, but we are inclined to consider only the larg forms as probable representatives of Verneuilina. Fossilizatio such as these forms suffered would perhaps replace finely arenaceo material with colloidal homogeneous silica such as that which bo these types now possess. It is even possible, though not probabl that the forms we have placed under Bulimina were of this genu but unless some means can be discovered to determine the positio and shape of the aperture, such problematical relations can not b determined. Cross and transverse sections would not indicate th aperture, and in no case do we find the necessary evidence to mak certain our identification. We are therefore provisionally placin all such forms under one species, Verneuilina pygmae (Egger).

Verneuilina pygmaea (Egger)

Plate 2, figures 1*a*, *b*; 2*a*, *b*

Bulimina pygmaea Egger, 1857, Neues Jahrb. fur Miner. p. 28 pl. xii, figs. 10, 11

Verneuilina pygmaea Brady, 1884, Chal. Rept., 9: 385, pl. xlv figs. 4–7

The close relationship between the two forms Bulimina and Ve neuilina is suggested by the fact that this type was originally wrongl placed under the former genus. The species designated pygmae is short, stoutly built and with few chambers. These are globose an projecting and widely expanding above. Cross sections woul therefore closely resemble Bulimina pupoides which w believe occurs in the chert. We are assigning to the genus Verneu lina a few doubtful rather large forms whose transverse sections ma perhaps belong to this genus. It seems to the writer all the mo probable since Verneuilina is known from the Cambrian while Bul

as never been so reported. Without the position and shape of erture such types could not be separated in rock slides.

best illustrations of the genus are found on slides 2, 3, 4 and 5 On slide 5 the form is cut vertically and reveals a partial seg- at both extremities; the separation and size of the segments ry suggestive of Verneuilina.

Genus **BULIMINA** d'Orbigny

genus Bulimina consists of an elongated, spiral textularian in which the final segments are large and overlapping and its development never symmetrical as in its related subvarieties lina and Bolivina. This form has been identified in the Triassic very succeeding formation, but it increases in the Tertiary many species are known. We do not find this genus, however, led in Lower Paleozoic strata; but, since both its relatives lina and Bolivina occur rather frequently in these cherts, it is all unlikely that the irregularly-built Buliminae are also present. nd a few sections quite similar to those Buliminae inhabiting waters today, but they are small, somewhat imperfect and difficult to be positive about. Bulimina shows more sphaeroidal nts than its congenitor Virgulina, so well developed on slide 2. walls of both these genera are thin, hyaline and originally must resembled those of the Cretaceous varieties which we would t to exist in rather deep water. These are, however, much er than the usual fossil types, the specimen we provisionally under B. p y r u l a measuring but 0.08 mm in length.

Bulimina pupoides d'Orbigny

Plate 2, figures 3, 4

limina pupoides d'Orbigny, 1846, Foram. Foss. Vienne, p. 185, xi, figs. 13, 14

limina pupoides Williamson, 1858, Recent Foram. Great Britain, 62, pl. v, figs. 124, 125

limina pupoides, Bagg, 1905, U. S. Geol. Survey, Bul. 268, p. 22, l. iii, fig. 2

ulimina pyrula has been reported from the Trias but o not know of an earlier occurrence of the genus Bulimina. s possible that we have wrongly identified B u l i m i n a oides d'Orbigny, which appears in transverse section on 2 (see also slide 1), as no triserial, bulimine type can be satisrily determined in cross section. However, the form in question s bulimine growth, overlapping, shortened segments with

depressed margins and few segments, as often seen B. pupoides. There are no distinct intermediate segm such as I should expect in triserial types, but the irregularity, general contour and disposition of segments seem to justify placing of this specimen under a true Bulimina and near pupoides d'Orbigny.

The species has been recorded in the Cretaceous of Minnes but if the present determination is correct, the genus is pre in the Lower Paleozoic.

Bulimina pyrula d'Orbigny

Plate 2, figures 5, 6

Bulimina pyrula d'Orbigny, 1846, Foram. Foss Vienne, p. 184, p figs. 9, 10

Bulimina pyrula (var. of Bulimina presli,) Parker Jones, 1865, Phil. Trans., 155: 372, pl. xv, figs. 8, 9

The section found on slide 1 near Pulvinulina mich liniana (d'Orbigny) shows four or five segments unsymmetrical biserial development. The section is problemati but seems to represent this species, although we can not be posi without further material for study. There are several reasons w however, this is probably correct. In the first place B. pyru has a long geologic history, being known from early Trias d to the present, and is found in every horizon from the base of Mesozoic up. Again, this is a somewhat more simply built t than the more elongate, triserial, overlapping forms of the Terti and, third, two related subgenera are present in considera numbers. Furthermore, this species is of wide geographic ra today, and is known from shallow waters down to depths of nea 3000 fathoms.

Genus **VIRGULINA** d'Orbigny

The genus Virgulina was founded by d'Orbigny to include th intermediate forms between Bulimina and Bolivina. Bolivina biserial as in Textularia, but its aperture is a narrow arched facing downwards and situated at or just below the distal mar In Virgulina and Bulimina it is often some distance below, and the inner face of the ultimate segment. In Bolivina the tes symmetrical and biserial, while in Virgulina the shell elongat often gives place to either very irregular, arched, biserial mentation, or it assumes a unicellular alternate growth someth

eurostomella from which genus it is sharply defined by its arrangement and different primordial chambers. Bulimina triserial, but in its unsymmetrical serial extension it resembles na. Moreover, in living forms Virgulina is a delicate, hyaline, alled, calcareous foraminiferan like Bolivina, while Bulimina larger, thicker shelled, and more roughly constructed than mer. All Bulimina types, however, show wide variation in rrangement of chambers, which is always more or less complex verlapping. This is true of Virgulina, which changes from l to uniserial growth and shows the most widely divergent arity in the symmetry of its chambers. In Bolivina there ually a large number of segments and they are of uniform size y unfold. In Virgulina, however, these do not match but o irregularly and unevenly and are much more strongly when shown in cross sections.

vina and Bulimina are both known from early Trias deposits; irgulina has, as far as we are aware, never been recorded in Paleozoic strata. It has been recorded from the Cretaceous becomes more frequent in the Tertiary, and exists today in vide oceans without regard to depth or latitude. We recognize l species of this unique genus in the Bonaventure chert and llowing illustrations, chiefly from slide 2, indicate the general uction of the species which in a measure are so closely related hey are to be regarded rather as subspecies than widely ent forms.

Virgulina schreibersiana Czjzek

Plate 2, figures 7, 8

imina presli var. (Virgulina) schreibersii, Parker & nes, 1865, Phil. Trans., 155: 375, pl. xv, fig. 18, pl. xvii, figs. 72, 73
gulina schreibersiana Goës, 1894, K. Sv. Vet. Akad. Handl., 25, no. 9, p. 48, pl. ix, figs. 459; 461–72

s with some difficulty that this species is separated from the y related form, V. squamosa d'Orbigny, when viewed nsverse section. It is however, somewhat more rounded at rimordial end, consists of fewer chambers and the segments most uniserial above with more pronounced depressions at the es. There are but five segments in one of the forms identified, seven or eight occur in V. squamosa on the same slide. orm described by Jones, 1895 (Pal. Soc., 49:166, pl. vi, fig. 20) the varietal name obesa, according to our opinion belongs here.

Virgulina squamosa d'Orbigny

Plate 2, figures 9, 10

Virgulina squamosa d'Orbigny, 1826, Ann. Sci. Nat., 7: 267, n
Modele, no. 64

Virgulina squamosa Goës, 1894, K. Sv. Vet. Akad. Handl., v
no. 9, p. 47, pl. ix, figs. 454–56 and 460

This species is similar to Virgulina schreibersia
Czjzek; but it has more segments and is, as a rule, more apicul
while its later, rapidly enlarged, irregular segments become ne
biserial.

There are eight chambers in the form selected from slide
illustrate this species and the margin is more or less limbate.
believe that this species is more representative and abundant t
either of the two included with it.

Virgulina subsquamosa Egger

Plate 2, figures 11, 12

Virgulina subsquamosa Egger, 1857, Neues. Jahrb. für Mi
p. 295, pl. xii, figs. 19–21

Virgulina subsquamosa Goës, 1894, K. Sv. Vet. Akad. Ha
v. 25, no. 9, p. 49, pl. ix, figs. 473–74

A six-chambered transverse section of slide 2 appears to be
here. This is to be regarded as a subvariety only of
squamosa in which the ends are rounded; in V. squamo
the distal margin is sharp and almost apiculate.

Virgulina sp.

Plate 2, figure 13

On slide 3 occurs a symmetrically, rapidly expanding Virgu
which we are unable to place, as all published types of this ge
seem to be relatively narrow in proportion to length. This s
is acuminate but the widely expanded anterior end is
Textularia trochus. The ultimate chamber is arc
but somewhat angular and we believe the form has never b
described. As it is impossible to determine its entire construct
we do not wish to give it a specific name. The shell measure
length 0.25 mm and 0.13 mm across its oral extremity.

Genus BOLIVINA d'Orbigny

The genus Bolivina has already been discussed under Virgu
and compared with its relatives Bulimina and Textularia. It
smaller type than Textularia, from which it differs always by

.re. The shell is finely punctate and delicate in segmentation; oss sections of this genus can be separated from the more on textularian type, even though the distinctive feature of erture is lacking.

s type is one of the oldest of all Foraminifera and was described arenberg from the "Silurian Clay" of St Petersburg, now to be of Lower Cambrian age. We identify two types of enus in the Bonaventure chert, but they are not typical of species to which they are assigned. The shorter, widely ding form may possibly be new; this is discussed under the ption of the form. One of these species, B. reticulata ken, was found in strata of Triassic age and described by z in his report on the Trias Foraminifera from Bakony.

Bolivina dilatata Reuss

Plate 3, figures 1, 2

livina dilatata Reuss, 1849, Denkschr. Akad. Wiss. Wien, 1: 1, pl. xlviii, fig. 15

livina dilatata Goës, 1894, K. Sv. Vet. Akad. Handl., v. 25, v. 9, p. 50, pl. ix, figs. 482–86

livina dilatata Brady, Parker & Jones, 1888, Trans. Zool. Soc., : 221, pl. xliii, figs. 3 and 6

find on slide 6 a short, widely oval, few-chambered Bolivina. type does not correspond exactly with any published figures as we are aware for several reasons, and we are inclined to ler it a new type. The form nearest to this species, so far e know, is Bolivina reticulata Hantken. It also ibles closely in outline B. tenuis, Brady (Challenger rt), but the latter has a complex internal segmentation not nt among simple bolivine forms. The B. dilatata of exts has many chambers, and it expands toward the distal ber like a Textularia, to which genus Bolivina is related. The ents are not quite complete and sure of identification so that difficult to place this form with certainty. The gracefully d segments narrow toward the margin, and this constriction t so marked in B. dilatata.

is more likely that this is a primitive type of form which devel- into symmetrical, elongated, rapidly widening Bolivinae of geologic horizons. The form would merit a new name if the ce features and full structure could be made out. The distal s sharp and almost apiculate; the anterior, well rounded, oval measures 0.18 mm in length and 0.16 mm in width, which is

very different from the type B. dilatata Reuss. Perh a more typical specimen is one of the two Bolivinae seen on slid in close proximity. Other specimens are shown on slides 1 a 5 (X), the latter being the one figured.

Bolivina punctata d'Orbigny

Plate 3, figures 3, 4

Bolivina punctata d'Orbigny, 1839, Foran. Amer. Merid., p. 61, viii, figs. 10–12

Bolivina punctata Vadász, 1910, Triasforam. aus dem Bakó p. 15, pl. 1, fig. 7

In addition to the stoutly built and wide spreading Bolivi there occur two or three delicate, still more minute, Bolivinae wh seem to belong to B. punctata. The only doubt lies in t small number of chambers, as most examples of B. puncta carry many chambers in each series. Two of our types show five segments in a series, while many forms of this species sh from seven to twelve or more. The best example we have of t species measures but 0.10 mm in length.

It is not so common as B. dilatata, but is a type wh has been found in Triassic and later horizons. It appears to wanting in the Carboniferous of Europe.

Bolivina sp . . . . perhaps **B. reticulata** Hantken

Plate 3, figures 5–7

On slide 6 (see figure 5), near the northeast corner, is a cr section of Bolivina which has five widely inflated segments in ea series, strongly overlapping and highly arched on their extrem so that the outline closely resembles Bolivina reticula Hantken, but also Bolivina dilatata Reuss, though b of these species have more chambers in each series than does t present type. We are inclined to think that this is a new spec of Bolivina though it may be a variety of either of the above. shall consider it, however, a variety of B. reticulata as t reticulate surface might not show in cross section. In length t specimen measures 0.26 mm.

Genus LAGENA Walker & Boys

Several species of this simple unicellular foraminiferan are kno in Upper Cambrian deposits. A few of these were described Mr F. Chapman in his report on the Foraminifera of the Malver

[1] On Upper Cambrian Foraminifera from the Malverns; and on Some of Earliest Known Foraminifera. Quar. Jour. Geol. Soc., 1900, 56: 257–63.

number have been recognized and described from the Silurian.[1]
st two of the species mentioned in the above reports are present
ese cherts, namely Lagena globosa (Montagu) and
aevis (Montagu). If we attempted to separate the speci-
from slight modifications in the shell contour we should have
two additional species but it seems best to include such under
yms of the principal types. In the Bonaventure chert Lagena
ver an abundant fossil and it does not usually show its true
ne aperture or phialine neck; but there is one cross section
de 2 which shows such extension and makes more positive the
fication of the genus and species.

is not at all impossible that the so-called Orbulina
lis Matthew from the Cambrian of Hanford Brook, St
in's, New Brunswick, is a Lagena, for existing Orbulinae are,
as we know, truly globular in cross section even when an
ual chamber exists within its outer sphere. Some help in
guishing these can be obtained, however, from the comparative
f these forms, as Lagenae are minute and the Orbulinae much
and with larger pores as well as thicker shell.

also identify what appears to be Orbulina ovalis
hew, which is a larger type than Lagena; but, as we can not
tain the aperture and oral ending, we can not be absolutely
ive that the form described by Matthew is present in these
s. Since there seem to be several Globigerinae similar to
Matthew describes, we believe that O. ovalis is also
nt. The outline, however, of this shell would be identical
Lagena ovum which Chapman reported from the Upper
orian. The significance of the aperture found in Orbulina
lis Matthew is discussed later under the description of the
s Orbulina.

Lagena globosa (Montagu)

Plate 3, figures 8, 9

gena globosa Brady, 1888, Geol. Mag., n. s., Dec. iii, 5: 481–84,
l. xiii, figs. 1–3
gena globosa Vadász, 1910, Triasforam. aus dem Bakony, p. 17,
l. 1, fig. 11

e Lagena of above reference, figured by Brady, was from the
ian of Lower Wenlock age, while those described by Vadász
from the Trias.

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[1] Brady, Note on Some Silurian Lagenae. Geol. Mag., n. s., Dec. 3, 1888. 5:
4, pl. xiii.

There can be no mistaking this almost globular form of Lage
though it varies considerably in size, in amount of aperture a
neck elongation, and in the more oval and elongate type mer
into L. laevis. The flattened forms become L. laevigat
while similar roughened-surface types constitute L. aspe
and costate forms L. sulcata, all of which are modificatio
of this simple rounded Lagena. As Professor Brady points o
Lagenae, contrary to expectation, are not very common in P
carboniferous formations; but we would expect them to be mo
numerous in lower Paleozoic strata than any of the more compl
types. We believe that their absence can be partly accounted f
because of their delicate, thin shells and minute size, so that th
are not so readily preserved as larger and often more arenaceo
Foraminifera. According to Brady (loc. cit.), the only notices
Precarboniferous Lagenae published prior to 1888 occur in T. Rupe
Jones's list of Upper Silurian Microzoa given in the Geologic
Magazine for February 1881.

The largest Silurian specimens figured by Brady were 2 mm
diameter, which is much larger than most recent specimens. T
species occurs on slide 6, measuring 0.12 mm to 0.15 mm in diamet

Lagena laevis (Montagu)

Plate 3, figures 10, 11

Vermiculum laeve, Montagu, 1803, Test. Brit., p. 524
Lagena laevis, Bagg, 1912, U. S. Geol. Survey Bul., p. 48, pl xi
figs. 5–8, K, 10, 11, a, b, pl xiv, figs. 23, 24

The unicellular, oval-chambered, smooth Lagena, known a
Lagena laevis, is a small, elongated oval form with the apic
end more or less prolonged, but not so strongly so as in Lagen
clavata or Lagena gracilis. It closely resembles th
narrower forms of Lagena globosa; but the length
approximately double the width, one of the two forms found mea
uring approximately 0.05 mm in width and 0.10 mm in lengt
though we can not be sure that this includes the full aperture exte
sion of the original form.

There are two of these minute fossil Lagenae on slide 6 (als
found on slide 2). The species is known in the Upper Siluria
at the base of the Wenlock series in the Woolhope limestone fro
Wych, Malvern, England. Unless the original flanged neck
these English specimens has been lost in silicification, they we
probably without such ornamentation. The short aperture exte

s more likely to have been simple as shown in many published
of this species, such as the excellent wood cuts (figs. 3*a*,
. 17) of the Triassic forms found by Vadász in Bakony.
s of course a possibility that this type, shown in cross section,
agena marginata since there is no method of determin-
flattening of the margin in any cross section longitudinally
although this would at once be apparent in transverse view.
e this species has had such a long history, and since the
is the same as the type figures, we have little hesitation in
ng these two specimens to the above species.

geographical distribution of this species is worldwide in
g oceans, even in Arctic waters, and it is also known at great
. Many synonyms have been given to this species, perhaps
ost common being Lagena vulgaris Williamson (Rec.
. Great Brit., p. 4, pl. 1, fig. 5) and Phialina ovata
za (from Italy). Vadász mentions the frequent occurrence
species in the Protrachyceras Reitzi-zone of the Trias near
rs as well as from the Estheria-marl of Csopak. Lagena
is appears therefore to have a geological range equal to
ena globosa (Montagu).

judge from the illustrations given by Brady (Notes on Some
an Lagenae, Geol. Mag., n. s., Dec. iii, 1888, 5: 481–84, pl. xiii)
the Wenlock forms were coarser and larger than the more
al, minute specimens we recognize in the Bonaventure chert.

Lagena marginata (Walker & Boys)

Plate 3, figures 12, 13

rpula marginata, Walker & Boys, 1784, Test. Min., p. 2, pl. 1, fig. 7
gena sulcata var. marginata, Parker & Jones, 1865, Phil.
rans., 155: 355, pl. xiii, figs. 42–44, pl. xvi, fig. 12

ere is seen on slide 3 an oval Lagena with wide margin identical
L. marginata (Walker & Boys) which seems to belong
his species. We have no means of determining, however,
her this form is compressed, as a transverse section would be
sary to reveal this feature. The aperture appears as a depres-
centrally located, but the shell is somewhat more spherical
typical L. marginata forms.

the Challenger monograph Brady reports this cosmopolitan
from every sea and from most northern latitude to the
rctic ice fields. The depth also varies from shoal water to
nd 3000 fathoms. Geologically, the species is known in the

Cretaceous chalk which appears to be its earliest occurrence previously reported. The specimen we are describing measures 0.13 mm in diameter.

Genus NODOSARIA (Lamarck)

The genus Nodosaria is well represented in the Bonaventure cherts, but most of the forms belong to one species, Nodosaria radicula (Linné). This type is apparently the only form in any of our slides which is perfect, typical and unusually small. It is one of the earliest genera, occurs in Cambrian strata and becomes remarkably well developed in the Carboniferous period.

It is easily recognized. The only mistake possible is when a Testularian is cut on edge away from a median line, in which case it might be taken for a uniserial form. Some of our specimens even show the apertural opening from chamber to chamber as in existing types, and the whole specimens are remarkably and perfectly preserved. They are, however, all short forms, even when stoutly constructed; and have few chambers, some with but two or three and often only four. Several species of this genus occur, but none so frequently as the straight-shelled N. radicula which is shown in many sections.

Nodosaria (D.) communis (d'Orbigny)

Plate 3, figures 14, 15

Dentalina communis d'Orbigny, 1826, Annales des Sci. Nat., 7:254, no. 35

Dentalina badenensis d'Orbigny, 1846, Foram. foss. Vienne, p. 44, pl. i, figs. 48, 49

Nodosaria communis Bagg, 1912, U. S. Geol. Survey, Bul. 513, p. 54, pl. xvi, figs. 5, 8, 9

Dentalina inornata Reuss 1863, Sitzungsb. d. k. Akad. Wiss. Wien, 48:45, pl. ii, fig. 18

Four segments occur on slide 1 showing very characteristic features of Nodosaria communis, but belonging to the obliquely-set chamber variety approaching true Vaginulina types. The anterior margin, however, curves back as in the Dentalina forms, and the sutures along the border are slightly depressed, exactly as in Dentalina badenensis d'Orbigny, which this form so closely resembles. The primordial chambers are not visible, but from the four preserved it is evident that the shell consisted of about five, or possibly six, segments rapidly extending but with very arcuate septae.

The Carboniferous types figured by Brady (Pal. Soc., 30:127, pl. X, figs. 17, 18) show too many segments for the form we find,

t a cross section of these would well represent the chert sections. e interior is filled with a greenish, dark, granular material and e shell is large for this type.

Nodosaria radicula (Linné)

Plate 3, figures 16, 17

Nautilus radicula (Linné) 1767, Syst. Nat., 12th ed., p. 1164, 285; 1788, ibid. 13th (Gmelin's) ed., v. 1, pt 2, p. 3373, no. 18
Nodosaria lepida Reuss, 1860, Sitzungsb. d. k. Akad. W. math. naturw., cl., v. 40, no. 8, p. 178, pl. 1, fig. 2
Dentalina subrecta Reuss, 1860, ibid., p. 182, pl. 1, fig. 10
Nodosaria kirkbyi Richter, 1861, in Geinitz's Dyas, heft 1, p. 121, pl. XX, fig. 30
Nodosaria radicula Brady, 1876, Carbonif. Foram., Paleont. Soc., 30:124, pl. X, figs. 6–16
Nodosaria ovalis Schmid, 1867, Neues Jahrb, für Min. p. 588, pl. VI, figs. 50, 51

The cross section of Nodosaria radicula observed in e chert of slide 1 shows seven uniformly enlarging segments over- pping about one-half way the succeeding chamber. The aperture pening is distinctly visible on most segments, and the marginal tures are pronounced. The species is well represented by figures and 10 of the Carboniferous Foraminifera (Brady, loc. cit.) the rmer, N. geinitzi Reuss, and the latter, N. kirkbyi ichter. This species is rather closely related to Dentalina legans d'Orbigny, but the latter has many segments, while . radicula has seldom more than seven and often only four. Brady states that he did not discover this type in any horizon elow the Permian where, in England, it seems to be confined to ne Upper Magnesian limestone of that era. The species is recorded y Vadász as not common in the Trias of Bakony. The length one example measures 0.18 mm, but many forms of this species ccur in the cherts.

Nodosaria soluta Reuss

Plate 3, figures 18, 19

Nodosaria (D.) soluta Reuss, 1851. Zeitschr d. deutsch. geol. Gesellsch., 3:60, pl. iii, fig. 4, *a*, *b*
Dentalina globifera Reuss, 1855, Sitsungsb. d. k. Akad. W. Wien., 18:223, pl. 1, fig. 3
Nodosaria soluta Vadász, 1910, Triasforam. aus dem Bakony, p. 20, pl. 1, fig. 14
Nodosaria soluta Chapman, 1893, Jour. R. Microsc. Soc., p. 587, pl. viii, fig. 26

Many figures of this species indicate considerable variation both as to the number of chambers — usually from three to five, never very many — and also, what is more significant, as to the mucronate character of the primordial chamber. This is not, however, a constant character, and in cross sections such a feature would not appear unless the test were cut near the center.

This shell occurs today in the North Atlantic at depths of from 300 to 1360 fathoms, in the South Pacific from 125 to 1350, and it is reported from many localities outside the tropics. Geologically it has been reported from earliest Trias but is especially developed in Cretaceous formations.

The figure shown by Reuss as D. globifera is an excellent type but it has too many segments (twelve in the figure) for the Precarboniferous varieties. We find several sections, perhaps some fragmentary, of this species in the cherts before us. The best perhaps are those with five segments shown on slide 1 and on slide 6. Other examples are shown on slides 2 (figure 18) and 4.

Genus CRISTELLARIA Lamarck

Cristellariae are rare and doubtfully represented in the Bonaventure cherts, but two species seem to occur. The difficulty of identification lies in the fact that the aperture does not show in the cross sections found, and these must be present on the outer margin if the form were cut in a median line. The genus goes back to the Cambrian but does not seem ever to be a well-developed type until the beginning of the Trias. The earlier types are not involute but are well represented by a few-chambered, curved form which we identify as C. acutauricularis (Fichtel & Moll) described below.

Cristellaria acutauricularis (Fichtel & Moll)

Plate 3, figures 20, 21

Nautilus acutauricularis Fichtel & Moll, 1803, Test. Micr., p. 102, pl. xviii, figs. g-i

Cristellaria acutauricularis Chapman, 1900, Quar. Jour. Geol. Soc., 56:259, pl. xv, fig. 9

Mr Chapman says of this form "In outline the Cambrian specimen resembles a cristellarian of the C. acutauricularis type; but the chambers are remarkably few in number, there being apparently only four in the specimen under notice." This form came from the Upper Cambrian of the Malverns. On slide 3 we find a

m showing two segments only, but which we doubtfully place der this species. It is not at all typical, but the specimen seems be perfect and complete and much less involute than the gibba which we also identify in these cherts. A better specimen, shown on slide 5 (X) has four chambers.

Cristellaria gibba d'Orbigny

Plate 3, figures 22, 24

Cristellaria gibba d'Orbigny, 1839, Foram. Cuba, p. 63, pl. vii, figs. 20, 21

Cristellaria pulchella Reuss, 1862, Sitz. Akad. Wiss. Wien, 46: 71, pl. viii, fig. 1

What appears to be Cristellaria gibba occurs on slide 4, it, unfortunately for absolute identification, the external anterior argin of the ultimate chamber is broken away by a fissure occurring the chert, so that it is impossible to ascertain whether the aperture cristellarian or not. The segmentation is identical with the few pidly enlarging chambers of C. gibba, but there is a slightly ore involute structure than the type calls for. There are, however, ther wide variations in this species, near which must be placed . nuda Reuss, C. polita Reuss, Robulina concinna euss and many other intermediate forms between Cristelaria crepidula, with its thin complanate test, and the nticular involute Cristellaria rotulata (Lamarck). The lentification rests upon the outline, arched segments, five shown n the slide, and their rapid expansion upward. If, however, the perture is central the form is not Cristellaria but Pulvinulina, ear P. hauerii (d'Orbigny); but the faint marking near the eriphery at the third septal line is very like Cristellaria.

C. gibba has been identified from the Trias and every succeedng horizon; but it is best known as a Cretaceous and Tertiary form, nd is still found in the North and South Atlantic oceans at depths f less than 500 fathoms.

Genus POLYMORPHINA d'Orbigny

But few specimens of the undoubted Polymorphina character ppear in the Bonaventure chert. The genus is a particularly ifficult one to identify or to determine specifically, as cross sections f segments, often without the aperture position, do not enable ne to judge under what type a given specimen belongs. The forms ve find are mostly of very minute size; but one rather large form

which shows its oral termination occurs on slide 1 and this is much larger than any other forms found. It measures 0.25 mm in length or more than double the usual forms.

There is some doubt about this type; for it is not reported in Paleozoic horizons as far as we know, and it is a type best developed in Cretaceous and Tertiary formations. It has, however, been previously reported from the Upper Trias of Derbyshire (Parker & Jones) and is not rare in some of the Lias beds.

Polymorphina communis (d'Orbigny)

Plate 4, figures 1, 2

Guttulina communis d'Orbigny, 1826, Ann. Sci. Nat., 7:266 pl. xii, figs. 1–4; Modéle, no. 62

Guttulina communis d'Orbigny, 1846, Foram. Foss. Vienne, p 224 pl. xiii, figs. 6–8

Polymorphina communis Bagg, 1912, U. S. Geol. Survey Bul 513, p. 68, pl. xxi, figs. 13–15 (After Jones)

In segmentation this form is closely related to Polymorphina problema (d'Orbigny), but the former is acuminate at its oral end. P. communis has fewer chambers (usually three or four), but many forms placed under this species do not exhibit the contour and small segmentation the type demands. I can not detect the Polymorphina aperture on the ultimate chamber of the form seen on slide 3, which ought to appear if cut in median section. There is, however, a very distinct irregularity on the interior overlapping segments which is correctly placed for this feature and which we are confident is the indistinct or indefinite structure of the polymorphine type. There should be more segments if the form were P. problema, and they would be somewhat more globose. The form is very minute and measures but 0.10 mm in length and but 0.07 mm in greatest width. The rather deep sutures observed in the cross section (figure 1) are partly due to the high magnification, 232 diameters, as compared with the larger Tertiary type shown in figure 2.

Polymorphina communis has been reported from early Jurassic (Lias) strata, but we are not aware of its having been hitherto recorded in Paleozoic formations.

The species also appears to be present on slide 5 (X), but the aperture is not shown in the cutting. The aboral end is here a little more extended than the type, but there are four overlapping segments and the outline resembles this species.

Polymorphina compressa d'Orbigny?

Plate 4, figures 3*a*, *b*

Polymorphina compressa, d'Orbigny 1846, Foram. Foss. Vienne, p. 233, pl. xii, figs. 32–34
Polymorphina acuta d'Orbigny, 1846, Foram. Foss. Vienne, p. 234, pl. xiii, figs. 4, 5 and pl. xiv, figs. 5–7
Polymorphina compressa Parker & Jones, 1865, Phil. Trans., p. 361, pl. xiii, figs. 47–51

The few short, biserial (somewhat irregular) forms such as appear slide 1 are doubtfully placed under this genus. Polymorphinae e not abundant in the chert sections and it is not impossible for to be mistaken in confusing this genus with short and diagonally t Bolivinae or Virgulinae types. There is, however, in the above ction a strongly lobed margin and more globose segments than the above genera, and we are therefore placing this form with lymorphina. The specimen is not very distinct, and the segments e rapidly converging as would be the case in a compressed type; is feature requires continued focusing to bring the structure into ew. There are four and five segments visible in each series and e length approximates 0.10 mm.

The specimen of what appears to be Polymorphina ibba on this same slide, is much larger and measures 0.25 m, but the complete form is not seen. P. compressa is ten regarded as an elongate variety of P. lactea, but the vo are quite distinct and easily distinguished when typical speciiens are examined.

This species is supposed to be represented by casts in the Silurian Ehrenberg); but it first becomes frequent in Mesozoic strata, nd is rather a cosmopolitan form in existing oceans. Parker & rady's forms were from the Arctic ocean.

Polymorphina gibba d'Orbigny

Plate 4, figures 4, 5

Globulina gibba d'Orbigny, 1826, Ann. Sci. Nat., 7:266, no. 20
Globulina gibba d'Orbigny, 1846, Foram. Foss. Vienne, p. 227, pl. xiii, figs. 13, 14

A cross section on slide 1 (also slide 6) resembles closely Polymorphina gibba d'Orbigny. One side of the form n the lower border is broken away by a fissure in the slide; but seems likely that the interior initial chamber was connected

to the large, ultimate, elliptical segment, as would be the case wit this species. The form is much larger than in the specimen c P. compressa and measures 0.25 mm in length. The outlin is broadly oval with prolonged aperture, a little eccentric, an shows but two well-defined chambers, the inner one more nearly ci cular and impressed against one side.

Typical specimens show more spherical shape than the one w are describing, which is more like P. lactea in some respect than P. gibba. In the latter there is a different arrangemen of segmentation, and the form is more minute; but there are man closely related types such as P. aequalis, P. lactea, Globulina punctata d'Orbigny, Globulina amplec tans Bornemann, and the variety G. orbicularis, as als P. (Guttulina) deformata Reuss, the latter being some what similar to the type we are discussing. A few specimens o other slides may belong to this type, but Polymorphina is a har genus to identify in cross section, as only the outline of segmen arrangement can be seen.

P. gibba is known from the Trias of Europe and is found i existing oceans.

Genus ORBULINA d'Orbigny

The genus Orbulina has been recorded from Cambrian strata o New Brunswick, from the Devonian of Paffrath in the Eifel, in th Trias of Bakony, and in every succeeding period; and is toda one of the most abundant pelagic species of every ocean. Nor mally there is no aperture in Orbulina, which makes the Orbu lina ovalis of Matthew from the Canadian Cambrian extremel problematical. It is more likely that the form is Lagena instead but we shall follow Matthew and recognize this type, since in ou specimens no aperture occurs and the shell is not circular a O. universa requires.

We therefore with some reservation recognize both O. uni versa and O. ovalis in the cherts under investigation and a still more problematical large form, O. porosa. The las is known in the Trias and is a large, stoutly built type. Toda Orbulina universa is a small form, with thin and delicat shell wall. Our fossil specimens are large for the type, and no all are truly spherical.

Orbulina ovalis Matthew

Plate 4, figures 6, 7

Orbulina ovalis Matthew, 1893, Trans. N. Y. Acad. Sci., 12:112, pl. 1, fig. 20

Orbulina ovalis Matthew, 1895, Trans. N. Y. Acad. Sci., 14:110, pl. 1, fig. 2

Orbulina universa of existing oceans is always spherical and normally built of a single chamber. There are occasionally met with double-chambered types in which the segments are ingrown and not bilobed, as in Globigerina bilobata, which never exhibit this sphericity. Such elongation as these types exhibit may belong to the species figured by Matthew as Orbulina ovalis. It is not altogether certain that the few elongated and apparently unicelled Foraminifera, such as are seen on slide 1, really belong here; but it seems probable that they do. There is a very peculiar and irregular distribution of minute circles seen in the cross section of one form shown on this slide, and if these represent chambers our determination is erroneous. In any case, however, oval types are observed which seem to belong to the above species and which may perhaps be allowed to stand.

Orbulina porosa Terquem

Plate 4, figures 8, 9

Globulina porosa Terquem, 1858, Foram. Lias, 1st Mem., p. 633

Orbulina liasica Terquem, 1862, Foram. Lias, 2d Mem., p. 432, pl. v, fig. 4

Orbulina porosa Vadász, 1910, Triasforam. aus dem Bakony, p. 29, pl. 1, fig. 30 (errata for 31)

This species of Orbulina differs from O. universa, the common, unicellar, globigerine type, in the coarseness of its pores and the asperate surface. In fossil form it appears in cross section as a roughened, crenulation-like surface, exceedingly minute; but it seems to be sufficiently distinct to be recognized in some forms on slide 6. It is rather larger than O. universa, although this is a minor factor in its identification. The specimen referred to has a diameter of 0.17 mm.

The species seems to have been not infrequent in a number of early Mesozoic horizons; but is an exceedingly rare type today, and we have never identified it in existing oceans. The Challenger reported the type from several stations, one in the North Atlantic at 1750 fathoms and another at 1485.

Orbulina universa d'Orbigny

Plate 4, figures 10–13

Orbulina universa d'Orbigny, 1839, Foram. Cuba, p. 3, pl. 1, fig.

We have stated that Orbulina universa appears to lack an orifice, and that thousands of specimens examined by Brady in his Challenger Report material failed to discover any with such opening. D'Orbigny, in his early reports, states that he found such openings, but only on about one-sixth of the material examined. We surmise that such openings existed only in fossil types, due to some weak development of the test and not to biologic design and permanent physiologic feature.

There are many minute, and a few large, nearly circular cross sections of Orbulinae on these chert slides; but not all are true spheres such as O. universa calls for. These are probably more numerous than our survey shows, for some may be cut away from the center and some may have been originally slightly unsymmetrical. Examples appear to be shown best developed on slides 2, 3 and 6, and a two-chambered form, doubtfully placed here on slide 2 (also slide 6). It is entirely possible that Globigerina bulloides cut near its ultimate segment would reveal a similar outline in section. We consider, however, the type to be present in all material studied.

Genus GLOBIGERINA d'Orbigny

The genus Globigerina, by far the most abundant and widespread of the pelagic Foraminifera of today, represents a well-circumscribed distinct group of involute, somewhat globular-chambered forms. Orbulina is the simplest type of the larger family which by multiplication of segments becomes most complex in G. cretacea. It is, like Orbulina, known in the Cambrian, and there is seldom any report upon fossil Foraminifera of any age which does not reveal this genus. In the fossil world, however, it is not well represented specifically, most forms being placed under a very few species of which the entire known series is relatively small. We have, however, in the Bonaventure cherts a remarkable development of Globigerina, and it is present in every section examined. Moreover, there is a wide divergence in size, segmentation and in variety of species which we could hardly look for in so early a formation. Many of these types appear to be identical with the forms described by Matthew in the Canadian Middle Cambrian of Hanford Brook, St Martin's and it is not unlikely that some of

t se cherts date back to that epoch. This will be referred to t ler our discussion of the age of these cherts. The chert types y greatly in size, measuring from but 0.10 mm in some of the aller forms to 0.28 mm in the larger specimens.

Globigerina aequilateralis Brady

Plate 5, figures 1–3

Globigerina aequilateralis Brady 1879, Quar. Jour. Micros. Sci., n. s., 19: 71

Globigerina aequilateralis Brady, 1884, Chal. Rep't, 9:605, pl. lxxx, figs. 18–21

Globigerina aequilateralis Goës, 1894, K. Sv. Vet. Akad. Handl., Bd. 25, no. 9, p. 86, pl. xiv, fig. 767

It seems strange that the large, coarsely constructed, aequilateral obigerina, doubtfully known under the name Phanerostomum asperum Ehrenberg, from the island of Rugen Chalk uld possibly go back into Lower Paleozoic time; and we have therto considered that this type belonged entirely to modern eans, although it is known in the Miocene. The large, globular-ambered Globigerina showing three well-defined but large segents, with a partial view of a fourth on one side, seen on slide 6, pparently belongs here. It has thick walls, anastomosing segments, id measures 0.2 mm in transverse section. There is an infilling ith clouded greenish brown material. The form is too large for . cretacea and shows too widely-jointed chambers to be lentified with G. pachyderma, which it seems to resemble some particulars.

A partial section, also on slide 6 and showing but three chambers, pparently belongs here also. On slide 2, there also appears a rge Globigerina filled in its interior with the same greenish brown bstance found on slide 6; and we believe this also represents he G. aequilateralis of existing oceans, but only four egments are seen in this example.

Globigerina bilobata d'Orbigny

Plate 4, figures 14, 15

Globigerina bilobata d'Orbigny, 1846, Foram. Foss. Vienne, p. 164, pl. ix, figs. 11-14

There are numerous bilobed Foraminifera on nearly all the slides, nd among these is undoubtedly the two-lobed G. bilobata 'Orbigny. There is always a possibility, however, that some of

these cross sections do not represent Globigerina, but Textulari globulosa forms which are very abundant as well. In the latte case, however, they would be very minute and the septal divisio distinct and marked by almost straight septal lines between eac series. Moreover the segments in Textularia should be of equa size.

The large forms ascribed to Globigerina with but two segment symmetrically developed and of unequal size belong to the abov species. The two-lobed Globigerina in which the segments ar of equal size and often with affluent chambers belongs to th G. didyma of Matthew. One example on slide 1 measure 0.21 mm and has well-defined walls with chambers confluent at th center, which would not hold true for T. globulosa Ehrenber cut on end. The G. bilobata are generally smaller tha G. didyma Matthew.

Globigerina bulloides d'Orbigny

Plate 4, figures 16, 17

Globigerina bulloides d'Orbigny, 1826, Ann. Sci. Nat., 7:27 No. 1: Modéle, no. 76 and young no. 17

Globigerina bulloides Cushman, 1918, U. S. Geol. Survey Bu 676, p. 12, 32, 56, 79, pl. iii, fig. 2; xii, figs. 4, 6

The most abundant of all Globigerina found in these cherts belong to the above species. It is especially well developed on slides 1, 3 5 (X) and 6. The diameter of these specimens varies widely, partl due to the various angles at which the sections are cut. The wall are well developed and occasionally relatively thick, and the limit of the forms measured varied from 0.11 mm to above 0.21 mm across the entire specimen. Very few cross sections would of cours reveal the entire segmentation of a rotaline spiral form like Globi gerina, even though it were relatively depressed at the apex The more widespread, angular chambered types belong to G cretacea d'Orbigny, but these are not very frequent in an of the sections examined.

Globigerina bulloides var. Triloba Reuss

Globigerina triloba Reuss, 1849, Denks. Akad. Wiss. Wien, 1:374 fig. 11

Several trilobed Globigerinae occur in the cherts but they diffe from Globigerina bulloides d'Orbigny only in possess ing three segments and we have therefore omitted illustration

his subspecies. All forms placed here are much smaller than coarsely built, large and irregular, three or four-lobed Globigerina tified as Globigerina cambrica Matthew.

Globigerina cambrica Matthew

Plate 4, figures 18, 19*a*, *b*

Globigerina cambrica Matthew, 1895. Trans. N. Y. Acad. Sci., 14: iii, pl. i, figs. 5a, 5b, 5c and 6 (G. grandis)

Several multilocular, but irregular, Globigerinae closely related trilobate Globigerina bulloides were described by thew as new species. The irregularity of segmentation as com-ed with typical G. bulloides serves to help differentiate e primitive few-chambered forms from those inhabiting recent ans. On slide 1 is a Globigerina which seems to belong to this e. Another is found on slide 2.

Globigerina cretacea d'Orbigny

Plate 5, figures 4, 5*a*, *b*

Globigerina cretacea d'Orbigny, 1840, Soc. Geol. France, Mem. 1st ser., 4:34, pl. 3, figs. 12–14

Globigerina cretacea Woodward & Thomas, 1884, (1885) 13th Ann. Rep't Geol. Survey Minn., p. 171, pl. ii (D), figs. 18, 19

Globigerina cretacea Cushman, 1918, U. S. Geol. Survey Bul. 576, p. 56, pl. xiii, fig. 3

Globigerina cretacea represents a widespreading, multi-mbered Globigerina in which the final whorl contains not less n six and often several more segments. These chambers when in sections tend to angularity within, and this is especially true the inner chambers. This same feature is sometimes revealed Rotalia, but in the latter the walls possess interseptal canals such are never found in this genus.

One of our specimens shown in slide 1 has twelve segments, seven which are in the final convolution. The spherical segments own above may not represent the entire number originally present; t they can not be far from that, and the section must have been near the median line of the shell. G. cretacea is not well own in existing oceans, but best belongs to the Chalk formation. e have identified it in the Cretaceous of New Jersey and the aryland Miocene, and Cushman's specimen was from the same rizon. Burrows, Sherborn & Bailey record it from the English d Chalk but we do not find it recorded from any horizon earlier n the Cretaceous. I think we are correct, however, in the ntification of this species in the chert material.

Globigerina didyma Matthew

Plate 4, figures 20, 21 *a*, *b*

Globigerina didyma Matthew, 1895, Trans. N. Y. Acad. S 14:111, pl. 1, figs. 7a, b. (Not Matthew, ibid, v. 12, pl. 1, figs. 1 and 4)

In addition to typical Globigerina bilobata d'Orbig formed of two chambers, such as seen on slide 1 where the segmen are somewhat smaller and of unequal size, there occur a numb of specimens on this same slide where the segments are larg thicker walled and of nearly equal diameter. Such varieties cons tute the Globigerina didyma Matthew described fr the Cambrian (Middle) of Hanford Brook, N. B. (Div. 1 band

Matthew's description reads as follows: "Multilocular, probab consisting of four chambers, of which the two final ones are of near equal size. There is an arched mouth at the edge of the fi chamber, on the opposite side from that whereon the small prima chambers are situated."

. There is not much ground for recognizing such subspecies Globigerina didyma or Orbulina ovalis fr modified forms of Globigerina bilobata, trilobat and Orbulina universa which have long been establishe Matthew is right, however, in separating these modifications, varietal subspecies of true Globigerinae, from the more compl and highly multichambered G. cretacea and G. bulloid of existing oceans. As cross sections of four-lobed Globigerin would give forms shown as two lobed, we believe we are right making a distinction between G. bilobata and G. didym and feel that these really represent primitive forms of this importa genus.

Genus **DISCORBINA** Parker & Jones

The name Discorbina so long used and well established in foraminiferal literature has recently been replaced by Dr J. Cushman and written Discorbis Lamarck. As this does n accord with the termination of the genera among Foraminifera a as Lamarck in the same report used the term Discorbites whi later was used for Discorbis, Discorbina and Rosalina, we do n care to adopt this term or spelling. Moreover, the term Discor has been used by few students of the Foraminifera; and the Engli paleontologists, in papers as late as 1917, retain the term Discorbi

The genus does not seem to be so well represented in early Paleoz formations as the more highly constructed related genus, Rotal which is present in Silurian strata and is well known from the Tri

The segments are often very highly curved or arched, the thin and the periphery sharp. We identify one species which s to belong here.

Discorbina orbicularis (Terquem)

Plate 5, figures 6, 7*a*, *b*

osalina orbicularis Terquem, 1876, Anim. Plage de Dunkerque, o. 75, pl. ix, fig. 4, a, b

iscorbina orbicularis Parker & Jones, 1896, Paleont. Soc., 50:295, pl. vii, fig. 31, a-c

iscorbina orbicularis Vadász, 1910, Triasforam. aus dem Bakony, p. 31, pl. 2, fig. 4 (Called D. orbicularis d'Orbigny sp. instead of Terquem)

iscorbina orbicularis Jones, 1896, Pal. Soc., 50:295, pl. vii, fig. 31, a-c

his species must not be confused with the Rotalia orbiaris d'Orbigny, probably the form described originally by rbigny in 1826 as Discorbis orbicularis, and also oidina, as this is a true double-walled septal type such as Rotalia of today's literature. We follow Brady in this nomenure, both genera and both species with which we are concerned ng discussed and described by him in his Challenger monograph. s type according to Brady is best developed today off coral s but is known from the North Atlantic as well as in southern ers off the coast of Australia. It has been recognized in off-shore osits down to 435 fathoms.

n our type there are but four chambers in the final whorl, highly hed and obliquely set; and there are three volutions altogether nprising between fourteen and sixteen segments with the central mber slightly eccentric. The type is best shown on slide 6 1 measures 0.14 mm in diameter. The outer disc is not circular, the final segment overlaps unsymmetrically and the segments band and become wider on their outer margin. We think that ne of the transverse sections may belong to this type, but most such we identify are Pulvinulinae.

The species has been reported in the Trias of Bakony, in the ocomian of Surrey, England, and in various Tertiary deposits.

Genus TRUNCATULINA d'Orbigny

Of all rotaline forms present in the Bonaventure cherts, the nus Truncatulina is the most abundant. At least three distinct cies occur and there are many of these present. Fortunately

for their identification some are cut on edge and reveal the tr plano-convex outline, especially such as in T. lobatula.

I do not think this genus has ever been found in the Cambri although Truncatulina lobatula must certainly expected, since we have the higher genera, Pulvinulina and Rotali in deposits of this period. It has been described from the Carbo iferous of Europe where several species occur; it is known in eve horizon from that era and is one of the most widely known for in the seas of today. It is moreover found not only in all sea but down to greatest depths and in all sorts of deposits from sho sands to the radiolarian oozes of the Pacific abysses. It is n possible to establish the genus in every cross section, for Discorbin Pulvinulina, Rotalia and the like resemble this genus in transpare outline. In the cherts we find Truncatulina well preserved, of goo size with well-developed, numerous septa, and in all respects identic with forms existing at the present time.

Truncatulina boueana d'Orbigny

Plate 5, figures 8, 9

Truncatulina boueana d'Orbigny, 1846, Foram. Foss. Vienn p. 169, pl. ix, figs. 24–26

Truncatulina boueana Brady, 1876, Pal. Soc., 30: 139, pl. vi, fig. 1

Truncatulina boueana d'Orbigny is often include under the synonyms of T. lobatula, and we have ourselve so written it. The distinction, however, has been made, and ca be, for those few-chambered forms consisting of but nine segment as shown in the original description and figure. In slide 1 we fin a good example of such a type. There are seven segments preser in the final whorl and part of the eighth, the primordial chambe not being visible. The outer periphery is slightly lobed, but i has been etched and eroded away on several segments. The sept are somewhat more straight than in the type figures and in thi respect it approaches Pulvinulina micheliniana. A Pulvinulinae have as a rule less segments than most rotalian form it is not impossible that this form is P. micheliniana Truncatulina is, we believe, more apt to develop in earlier horizon than Pulvinulina of higher organization. The less arched sept are also more characteristic of Truncatulina than true Rotalia Pulvinulina, or Discorbina types.

The diameter is 0.10 mm in the maximum and 0.08 mm in th smallest of the specimens. This species must not be confuse

h Pulvinulina boueana d'Orbigny, which has a larger nber of arching segments and which is known as early as the as as shown by Vadász. On slide 3 is a large specimen 0.17 mm liameter and possessing more septa than the type calls for which are placing under this species.

Truncatulina lobatula (Walker & Jacob)

Plate 5, figures 10*a*, *b*, 11

Nautilus lobatulus Walker & Jacob, 1798, Adam's Essays, 2d ed., p. 642, pl. xiv, fig. 36

Truncatulina lobatula Williamson, 1858, Recent Foram. Great Brit., p. 59, pl. v, figs. 121–23

The synonymy of T. lobatula is one of the most extensive ong rotaline forms, and includes forms with considerable varia- n in number of segments, amount of marginal limbation and hing of septae; but its spire is low, superior surface always atively flat or even slightly depressed and there are from two three convolutions, the ultimate whorl showing normally about ht chambers. The cross sections of this species, which is rather undant in the cherts of the Bonaventure formation, show well- onounced marginal sutures, but the ultimate segment is more gular and gracefully convex than in many modern loose-growing rms. One of these sections on slide 1 consists of seven, five and o segments and resembles Rosalina simplex d'Orbigny the Paris Basin Eocene. An excellent section cut on edge (slide 1) id shown in figure 10*b* illustrates the plano-convex character of is interesting foraminiferan which has such a remarkable geographic id geologic distribution. It is reported in the Carboniferous, rias and every succeeding formation and is widespread in existing eans.

The species is probably present in every one of the six cherts udied, but the best and most representative specimens, in addition o those given above, are seen on slide 3, slide 4 and slide 6.

Truncatulina ungeriana d'Orbigny

Plate 5, figures 12, 13

Rotalina ungeriana d'Orbigny, 1846, Foram. Foss. Vienne, p. 157, pl. viii, figs. 16–18

Rotalia roemeri Reuss, 1855, Sitz. Akad. Wiss. Wien, 18: 240, pl. iv, fig. 52 (Typical in segmentation)

Truncatulina ungeriana Vadász, 1910, Triasforam. aus dem Bakony, p. 32, pl. 2, fig. 6 (Typical of our form)

In existing oceans Truncatulina ungeriana is reported from the Arctic and North Atlantic waters and has a wide bathymetric range. As a fossil it is better known from the Tertiary but has been reported from the Trias and Cretaceous horizons of the Mesozoic.

The original figure of d'Orbigny shows eleven segments in the ultimate whorl, but many published illustrations of this type among the older geologic formations show but nine or, as in our California Pliocene, but eight. The test is well widened at the border and slightly depressed at the sutures, this feature becoming more pronounced toward the ultimate segment There are sixteen chambers in one chert section (slide 3) and these are moderately arched with wide septa, curved and somewhat thickened at the periphery. When viewed on edge this species should show an almost plano-convex form with sharp periphery, as in Truncatulina wuellerstorfi (Schwager). Such a form occurs on slide 6 and is placed here. We are impressed with the rotaline form of this foraminiferan when seen in cross section; but there are no divided septal walls as in the higher type, and we believe we are right in ascribing the specimen to this species, although Truncatulina akneriana (d'Orbigny) would give a very closely related appearance in cross view. Another specimen, probably belonging here, is found on slide 5 (X) showing twenty segments; its diameter is only 0.10 mm.

Genus ANOMALINA d'Orbigny

The genus Anomalina belongs to the planorbuline forms of the rotaline group, and it is somewhat doubtful whether the genus should be retained. It has been extensively used, and the type is so well established, however, that we may continue this for rotaline forms of Truncatulina which are complanate and show on both surfaces the entire segmentation. It is in this respect similar to Nonionina or Polystomella, and, like these, possesses a high organization.

In the form we identify the septal walls show slight canal systems, or at least they are double as in the higher rotaline genera. We find but one example which seems to belong to this genus, and it is unusually large for the type and not cut in such a manner that its entire segmentation can be determined. It is rotaline, has double septa in the walls and is plano-convex; so that it would seem to be Anomalina although the genus has never been observed, so far as we are aware, in strata of Paleozoic age. It is best known as a Cretaceous fossil.

Anomalina grosserugosa (Gümbel)

Plate 6, figures 1, *2a*, *b*

Truncatulina grosserugosa Gümbel, 1868, Abhandl. bayer Akad. Wiss., II, Cl., 10:669, pl. ii, fig. 104, a, b

On slide 5 (X) we find a section of a double-walled, coarsely built and large rotaline foraminiferan in which the cutting has exposed three chambers set on edge. A still better specimen showing four segments cut on edge is seen on slide 1 and is used for our illustration in plate 6. This is one of the largest rotaline species observed and measures 0.27 mm across the four segments. These seem to be Anomalina grosserugosa (Gümbel), as they are too large for Pulvinulina and related hyaline types. We tentatively place these specimens under Anomalina, for if they were Nonionina there would be a canal system between the walls as in Rotalia. Since true Rotaliae are present in these cherts we can see no reason why Anomalina should not also be present. The specimen shown on slide 5 (X) measures 0.10 mm in diameter, but the shell must have been cut near the outer margin as but three segments occur.

Anomalina grosserugosa is known in late Cretaceous formations but we are not aware that it has hitherto been recognized in Paleozoic formations.

Genus PULVINULINA Parker & Jones

It is singular that Pulvinulina should have been recorded in deposits of Lower Cambrian age[1], as it is a beautiful example of higher rotaline forms. It is, however, constructed with fewer chambers than most of the related genera, but these vary in number from seven to twenty-six, and the shell wall is without a canal system. It is often prismatic in structure, approaching nummuline character, seen so well in Amphistegina and Nummulites. Brady in his Carboniferous monograph recognizes but one species of this genus, but this type is not present in our cherts. In some of the highest types a faint canal system develops, but it is not distinct as in Rotalia.

We recognize three species which seem to belong to this genus, and fortunately some of these are cut on edge so as to delineate the convex feature all such forms possess.

[1] Ehrenberg, Monats. Preuss. Akad. Wiss. Berlin, 1858, p. 324-27, pl. 1.

Pulvinulina boueana (d'Orbigny)

Plate 6, figures 3, *4a, b*

Rotalina boueana d'Orbigny, 1848, Foram. Foss. Vienne, p. 152, pl. vii, figs. 25–27

Pulvinulina boueana Vadász, 1910, Triasforam. aus dem Bakony, p. 33, pl. ii, figs. 9, 10

This species of Pulvinulina must not be confused with Truncatulina boueana d'Orbigny possessing only seven or eight segments. The septa are more arched and there are three whorls of about sixteen segments of which eight, or sometimes nine, are in the final volution.

This type is found on slide 1 and is an excellent example of the species.

This foraminiferan has been figured from the Septaria Clays by Reuss and the London Clays by Sherborn & Chapman, while the Trias specimens described by Vadász were from the Protrachyceras zone near Felsoors.

According to d'Orbigny, the species still lives in the Adriatic ocean, but it does not appear to have been identified or described by Brady in his exhaustive monograph on Recent Foraminifera of the Challenger Expedition. Brady gives as its isomorph forms Discorbina saulcii d'Orbigny, Truncatulina akneriana d'Orbigny and Rotalia exsculpta Reuss. Cross sections of these types in fossil form would be inseparable unless cut in transverse section instead of horizontal.

Pulvinulina elegans (d'Orbigny)

Plate 6, figures 5, *6a, b, c*

Rotalia elegans d'Orbigny, 1826, Ann. Sci. Nat., 7:276, no. 54

Pulvinulina repanda (Fichtel & Moll) var. elegans Parker & Jones, 1865, Phil. Trans., 155:397, pl. xvi, figs. 44–46

Rotalina partshiana (d'Orbigny) 1846, Foram. Foss. Vienne, p. 153, pl. vii, figs. 28–30, pl. viii, figs. 1–3

Pulvinulina elegans Goës, 1894, K. Sv. Vet. Akad. Handl., v. 25, no. 9, p. 97, pl. xvi, fig. 808

On slide 5 (X) we find a transverse section of a small, but stoutly built, conical Pulvinulina near P. elegans. The internal structure is somewhat nummuline as shown in published sections of its relative, Pulvinulina partschiana (d'Orbigny), from which this species is with difficulty separated. The lower surface is weakly convex, almost flat, while the superior face is highly coned. The segmentation is not fully determined in our

specimen; but there are three volutions or whorls visible, and under different focusing one can determine their general position. The shell wall is prismatic and thick, closely like the nummuline structure of Pulvinulina partschiana, shown on page 700 of the Challenger Report, volume 9, but the chambers are more circular than this type shows. Brady in his Challenger Report does not attempt to separate these two species; but considers P. partschiana a smaller, more convex, thinner walled form than P. elegans, and adds that P. elegans occurs more often in shoal waters while P. partschiana is usually a deep water form. On the other hand, he considers P. elegans more typical of warm waters, though occurring with its congenitor in all oceans.

Goës identified P. elegans in waters of the Arctic ocean and states that it is rare at 1750 meters. As a fossil it is better known than P. partschiana. It occurs from the Trias through succeeding formations, but is perhaps better known as a Cretaceous type.

The vertical transverse section we are describing measures 0.15 mm in length (diameter) and 0.07 mm through the cone apex. It is very probable that this form occurs in some of our rotaline cross sections; but, if so, they are difficult to identify or separate from other Pulvinulinae which we know occur in these cherts.

Pulvinulina micheliniana d'Orbigny

Plate 6, figures 7, 8*a*, *b*, *c*

Rotalina truncatulinoides d'Orbigny, 1839, Foram. Canaries, p. 132, pl. ii, figs. 25–27

Rotalina micheliniana d'Orbigny, 1840, Mem. Soc. Geol. France 4:31, pl. iii, figs. 1–3

Pulvinulina micheliniana Parker & Jones, 1865, Phil. Trans., 155:396, pl. xiv, fig. 16

A peculiar diagonal cross section of a form on slide 1 seems to belong to this species, but it is somewhat uncertain owing to the fact that not all segments are visible. The center chambers are perfect and distinctly rotaline; but the outer margin seems to be somewhat disconnected or discontinuous from these, which show on a vaulted and highly thickened wide margin a high and sharp edged spire. It is possible that this form is Truncatulina refulgens (Montfort) which is the isomorph of the Pulvinulina type; but from the thickened border and highly involute and many segmented inner whorls, I think it is more likely to be Pulvinulina than Truncatulina. If the indefinite and vaulted

external arch is not a part of the interior segments, then our determination is erroneous. Pulvinulina micheliniana has been found in Arctic waters today and is well known as far back as the Cretaceous, where it is rather common.

On slide 5 (X), near Textularia trochus, we find a transverse section which is almost certainly Pulvinulina micheliniana, as it is close to what a cross section of the type would be, the vaulted arch being less symmetrical than Truncatulina refulgens (Montfort). An excellent diagonally cut specimen is seen on slide 4 near the spined radiolarian.

Genus ROTALIA Lamarck

True Rotaliae form but a small, rather restricted, group as compared with Pulvinulina and Truncatulina. They possess true canal systems between the septal partitions and develop a high, turbinoid spire with many chambers. They are, however, often of minute size, and while today Rotalia is abundant in shore deposits of warm and temperate zones, it is known down to 3000 fathoms. When living in favorable shoal waters it is larger and may develop supplemental skeleton. It possesses minute pores like the nummuline forms, and the walls are of fine calcareous texture.

Geologically, Rotalia goes back to the lowest Cambrian; but it does not become abundant until Mesozoic time, and is especially prominent in Cretaceous and Tertiary formations. We have one very beautiful and large foraminiferan belonging to this genus, Rotalia orbicularis (d'Orbigny), which measures 0.38 mm in transverse width.

Rotalia orbicularis (d'Orbigny)

Plate 6, figures 9, 10

Gyroidina orbicularis d'Orbigny, 1826, Ann. Sci. Nat., 7:278, no. 1, Modéle, no. 13

Rotalia orbicularis Parker & Jones, 1865, Phil. Trans., 155:389, pl. xvi, fig. 34

Slide 5 (X) shows one of the highest rotaline types of Foraminifera, namely true Rotalia. Rotalia has double septal walls, which are very apparent in the higher magnification (x174) given this cross section. Canal systems are not present in many rotaline genera such as Cristellaria, but become highly specialized in Nonionina Polystomella and Nummulina. We regard the development of Rotalia as most remarkable. Were it not for this canal structure

we should hesitate to identify the genus in such an early occurrence; but there can be little doubt as to the correct generic type, although we are not so sure about the specific identification. This species seems to accord more closely with R. orbicularis than any other published form, but the margin is much more symmetrical and not so lobate as some figures of the species. The specimen consists of eighteen or possibly nineteen chambers, the last one broken away; and there are ten chambers in the last convolution and three volutions in all. The diameter is 0.013 mm, maximum width.

Rotalia orbicularis must not be confused with Discorbina orbicularis known from the Trias and later horizons. By Parker & Jones, R. orbicularis is considered a variety of Rotalia beccarii (Linné), but it is best to keep the two distinct. It occurs today in the North Atlantic and Arctic oceans and Parker & Jones describe the species as follows:[1] "This extremely delicate and minute abyssal variety of R. beccarii is but little removed from R. soldanii; but it is smaller, and has its upper face still flatter and smoother than in R. soldanii. It is in shape half an oblate spheroid, having the upper side flat, the lower forming a low rounded cone."

Fossil specimens have been recorded from the London Clays and the Eocene of Paris, and it seems to be widely distributed in the Tertiary. The genus Rotalia is reported from Silurian strata in the Llandovery beds but it does not seem to be at all common until the Mesozoic.

List of Foraminifera Identified in the Bonaventure Cherts of New Brunswick

1 Anomalina grosserugosa (*Gümbel*)
2 Bolivina dilatata *Reuss*
3 " punctata *d'Orbigny*
4 " reticulata *Hantken*
5 Bulimina pupoides *d'Orbigny*
6 " pyrula *d'Orbigny*
7 Cristellaria acutauricularis (*Fichtel & Moll*)
8 " gibba *d'Orbigny*
9 Discorbina orbicularis (*d'Orbigny*)

[1] Phil. Trans., 1865, p. 389

10 Globigerina aequilateralis *Brady*
11 " bilobata *d'Orbigny*
12 " bulloides *d'Orbigny*
13 " " var. triloba *Reuss*
14 " cambrica *Matthew*
15 " cretacea (*d'Orbigny*)
16 " didyma *Matthew*
17 Lagena globosa (*Montagu*)
18 " laevis (*Montagu*)
19 " marginata (*Walker & Boys*)
20 Nodosaria communis (*d'Orbigny*)
21 " radicula (*Linné*)
22 " soluta *Reuss*
23 Orbulina ovalis *Matthew*
24 " porosa *Terquem*
25 " universa *d'Orbigny*
26 Polymorphina communis *d'Orbigny*
27 " compressa *d'Orbigny*
28 " gibba *d'Orbigny*
29 Pulvinulina boueana (*d'Orbigny*)
30 " elegans (*d'Orbigny*)
31 " micheliniana (*d'Orbigny*)
32 Rotalia orbicularis (*Terquem*)
33 Textularia gibbosa *d'Orbigny*
34 " globulosa *Ehrenberg*
35 " gramen *d'Orbigny*
36 " pupa *Reuss*
37 " trochus *d'Orbigny*
38 Truncatulina boueana (*d'Orbigny*)
39 " lobatula (*Walker & Jacob*)
40 " ungeriana (*d'Orbigny*)
41 Valvulina sp.
42 Verneuilina pygmaea *Egger*
43 Virgulina schreibersiana *d'Orbigny*
44 " squamosa *Czjzek*
45 " subsquamosa *Egger*

EXPLANATION OF PLATES

Plate 1

193

GENUS TEXTULARIA DEFRANCE

Textularia gibbosa d'Orbigny

1 Thin section, x 58. (Slide 1)

2 Entire specimen, x 30. *a*, lateral view; *b*, end view. (After Brady, Pal. Soc., v. 30, 1876, pl. 10, figs. 26 *a*, *b*)

Textularia globulosa Ehrenberg

3 Thin section, x 174. (Slide 3)

4 Entire specimen, x 75. *a*, lateral (front) view; *b*, side view; *c*, end view. (After Jones, Pal. Soc., v. 49, 1895, pl. 6, figs. 18 *a*, *b*, *c*)

Textularia gramen d'Orbigny

5 Thin section, x 174. (Slide 4)

6 Entire specimen, lateral view, x 60. (After Cushman, U. S. G. S. Bul. 676, 1918, pl. 2, fig. 1*a*)

Textularia pupa Reuss

7 Thin section, x 174. (Slide 3)

8 Entire specimen. *a*, front view; *b*, side view. (After Reuss, Sitz. Akad. Wiss. Wien, v. 40, 1860, pl. 13, figs. 5 *a*, *b*. The largest example measured 1.2 mm in length; 0.62 mm in breadth)

Textularia trochus d'Orbigny

9 Thin section, x 116. (Slide 5 (X))

10 Entire specimen, x 12. *a*, lateral view; *b*, end view. (After Jones, Parker and Brady, Pal. Soc., v. 19, 1865, pl. 3, figs. 17, 18)

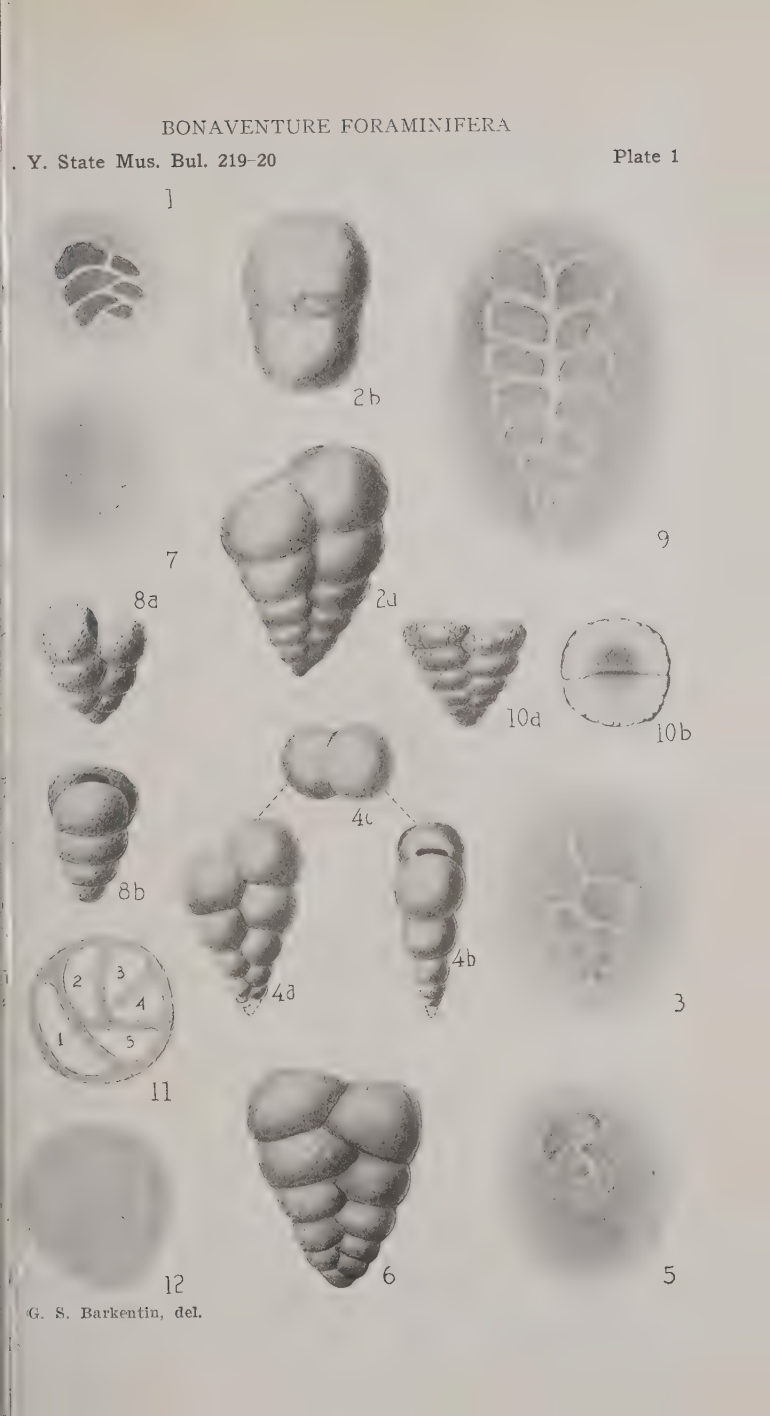
GENUS VALVULINA D'ORBIGNY

Valvulina sp.

11 Thin section, x 58. (Slide 1)

12 Thin section of a smaller type and different species, x 174. (Slide 4)

. Y. State Mus. Bul. 219–20



G. S. Barkentin, del.

Plate 2

195

GENUS VERNEUILINA D'ORBIGNY

Verneuilina pygmaea (Egger) ?

1 Thin sections, x 174. *a*, short, stout form; *b*, long for
(*a*, slide 2; *b*, slide 4)

2 Entire specimens, lateral views, x 35. *a*, short, stout for
b, long form. (After Brady, Chal. Rep't, v. 9, pl. 47, figs. 4,

GENUS BULIMINA D'ORBIGNY

Bulimina pupoides d'Orbigny

3 Thin section, x 174. (Slide 1)

4 Entire specimen, lateral view, x 175. (After Bagg, U. S. G.
Bul. 268, 1905, pl. 3, fig. 2)

Bulimina pyrula d'Orbigny

5 Thin section, x 290. (Slide 1)

6 Entire specimen, lateral view, x 25. (After Bagg, U. S. G.
Bul. 513, 1912, pl. 9, fig. 1*d*)

GENUS VIRGULINA D'ORBIGNY

Virgulina schreibersiana Czjzek

7 Thin section, x 174. (Slide 2)

8 Entire specimen, x 24. (After Parker and Jones, Phil. Tra
v. 155, 1865, pl. 15, fig. 18)

Virgulina squamosa d'Orbigny

9 Thin section, x 174. (Slide 2)

10 Entire specimen, length 1.16 mm. (After Goës, K. Sv. V
Akad. Handl., v. 25, 1894, pl. 9, fig. 456)

Virgulina subsquamosa Egger

11 Thin section, x 174. (Slide 2)

12 Entire specimen, length 0.48 mm. (Ref. cit., pl. 9, fig. 474)

Virgulina sp.

13 Thin section, x 116. (Slide 3)

G. S. Barkentin, del.

Plate 3

GENUS BOLIVINA D'ORBIGNY

Bolivina dilatata Reuss

1 Thin section, x 174. (Slide 5 (X))

2 Entire specimen, x 100. (After Brady, Parker and Jones, Trans. Zool. Soc., v. 12, 1888, pl. 43, fig. 3)

Bolivina punctata d'Orbigny

3 Thin section, x 232. (Slide 1)

4 Entire specimen, length 0.78 mm. (After Goës, K. Sv. Vet. Akad. Handl., v. 25, 1894, pl. 9, fig. 476)

Bolivina sp., perhaps **B. reticulata** Hantken

5 Thin section, x 116. (Slide 6)

6 Entire specimen of B. reticulata, x 70. (After Brady, Chal. Rep't, v. 9, 1884, pl. 53, fig. 30)

Bolivina sp. ?

7 Thin section, x 174. (Slide 6) This may be a shortened form of B. dilatata Reuss; its outline is nearer B. reticulata Hantken and B. tenuis Brady.

GENUS LAGENA WALKER & BOYS

Lagena globosa (Montagu)

8 Thin section, x 116. (Slide 6)

9 Entire specimen. (After Vadász, Triasforam. aus dem Bakony, 1910, pl. 1, fig. 11. Specimens with length 0.32 mm, 0.436 mm; breadth 0.2 mm, 0.4 mm)

Lagena laevis (Montagu)

10 Thin section, x 174. (Slide 2)

11 Entire specimen, x 15?. (After Bagg, U. S. G. S. Bul. 513, 1912, pl. 13, fig. 6*a*)

Lagena marginata (Walker & Boys)

12 Thin section, x 116. (Slide 3)

13 Entire specimen, x 24. (After Parker and Jones, Phil. Trans., v. 155, 1865, pl. 13, fig. 42*a*)

GENUS NODOSARIA LAMARCK

Nodosaria communis d'Orbigny

14 Thin section based on sketch by author. (Slide 1)

15 Entire specimen, x 8½. (After Bagg, U. S. G. S. Bul. 513, 1912, pl. 16, fig. 8)

Nodosaria radicula (Linné)

16 Longitudinal section. (After Brady, Pal. Soc., v. 30, 1876, pl. 10, fig. 10)

17 Entire specimen. (Ref. cit., pl. 10, fig. 6)

Nodosaria soluta Reuss

18 Thin section, x 174. (Slide 2)

19 Entire specimen. (After Vadász, Triasforam. aus dem Bakony, 1910, pl. 1, fig. 14*a*. Length 1.5 mm; breadth .0316 mm)

GENUS CRISTELLARIA LAMARCK

Cristellaria acutauricularis (Fichtel & Moll)

20 Thin section, x 116. (Slide 5 (X))

21 Entire specimen, x 70. (After Brady, Chal. Rep't, v. 9, 1884, pl. 114, fig. 17*a*)

Cristellaria gibba d'Orbigny

22 Thin section, x 174. (Slide 4)

23 Entire specimen, x 25. (Ref. cit., pl. 69, fig. 9)

N. Y. State Mus. Bul. 219–20

Plate 3

G. S. Barkentin, del.

Plate 4

GENUS POLYMORPHINA D'ORBIGNY

Polymorphina communis (d'Orbigny)

Thin section, x 232. (Slide 5 (X))

Entire specimen, periphero-lateral aspect. (After Bagg, U. S. G. S. Bul. 513, 1912, pl. 21, fig. 14)

Polymorphina compressa d'Orbigny

Entire specimen, x 24. *a*, front view; *b*, side view. (After Parker and Jones, v. 155, 1865, pl. 13, figs. 47, 49)

Polymorphina gibba d'Orbigny

Thin section, x 174. (Slide 6)

Entire specimen, x 120. (After Cushman, U. S. G. S. Bul. 676, 1918, pl. 2, fig. 4)

GENUS ORBULINA D'ORBIGNY

Orbulina ovalis Matthew

Thin section, x 116. (Slide 4)

Entire specimen, x 20. (After Matthew, N. Y. Acad. Sci., v. 14, 1895, pl. 1, fig. 2)

Orbulina porosa Terquem

Thin section, x 174. (Slide 6)

Entire specimen, diameter 0.32 mm. (After Vadász, Triasform. aus dem Bakony, 1910, pl. 1, fig. 30 (in error for fig. 31)

Orbulina universa d'Orbigny

Thin section of single-chambered form, x 116. (Slide 5 (X))

Entire specimen, x 50. (After Brady, Chal. Rep't, v. 9, 1884, pl. 81, fig. 11)

Thin section of double-chambered form, x 116. (Slide 6)

Entire specimen, x 50. (Ref. cit., pl. 81, fig. 20)

Globigerina bilobata d'Orbigny

14 Thin section, x 174. (Slide 1)

15 Entire specimen, x 175. (After Bagg, U. S. G. S. Bul. 268, 1905, pl. 7, fig. 8)

Globigerina bulloides d'Orbigny

16 Thin section, x 174. (Slide 1)

17 Entire specimen, x 50. (After Brady, Chal. Rep't, v. 9, 1884, pl. 79, fig. 7*a*)

Globigerina cambrica Matthew

18 Thin section, x 58. (Slide 1)

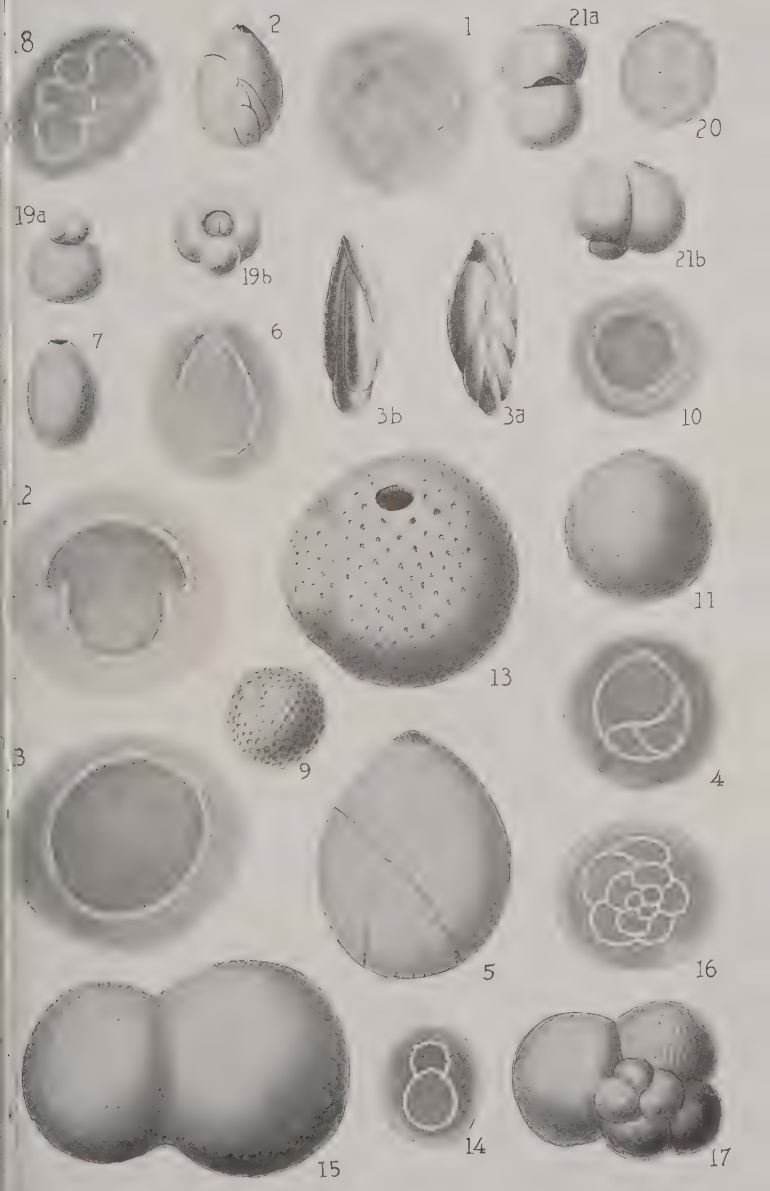
19 Entire specimens, x 10. *a*, with initial chambers external; *b*, with initial chambers internal. (After Matthew, N. Y. Acad. Sci., v. 14, 1895, pl. 1, figs. 5*a*, *b*)

Globigerina didyma Matthew

20 Thin section, x 58. (Slide 1)

21 Entire specimen, x 10. *a*, front view showing orifice; *b*, side view. (Ref. cit., pl. 1, figs. 7*a*, *b*)

N. Y. State Mus. Bul. 219–20



J. S. Barkentin, del.

Plate 5

GENUS GLOBIGERINA D'ORBIGNY

Globigerina aequilateralis Brady

1 Thin section, x 174. (Slide 6)

2 Entire specimen (bottom specimen), x 50. (After Brady, Chal. Rep't, v. 9, 1884, pl. 80, fig. 18)

3 Surface specimen, x 50. (Ref. cit., pl. 80, fig. 20)

Globigerina cretacea d'Orbigny

4 Thin section, x 174. (Slide 1)

5 Entire specimens. *a*, superior aspect; *b*, inferior aspect. (After Woodward & Thomas, 13th Ann. Rep't Geol. Surv. Minn., 1884 (1885), pl. D, figs. 18, 19)

GENUS DISCORBINA PARKER & JONES

Discorbina orbicularis (Terquem)

6 Thin section, x 174. (Slide 6)

7 Entire specimen, x 90. *a*, superior aspect; *b*, peripheral aspect. (After Brady, Chal. Rep't, v. 9, 1884, pl. 88, figs. 4*a*, *c*)

GENUS TRUNCATULINA D'ORBIGNY

Truncatulina boueana d'Orbigny

8 Thin section, x 174. (Slide 1)

9 Entire specimen, superior aspect, x 100. (After Brady, Pal. Soc., v. 30, 1876, pl. 6, fig. 11)

Truncatulina lobatula (Walker & Jacob)

10 Thin sections, x 174. *a*, cross section (slide 3); *b*, edgewise section (slide 1); these sections were important in the identification of the species

11 Entire specimen, superior aspect, x 60. (After Brady, Chal. Rep't, v. 9, 1884, pl. 92, fig. 10)

Truncatulina ungeriana d'Orbigny

12 Thin section, x 174. (Slide 5 (X))

13 Entire specimen, superior aspect; length 0.42 mm, thickness 0.22 mm. (After Vadász, Triasforam. aus dem Bakony, 1910, pl. 2, fig. 6*a*)

G. S. Barkentin, del.

Plate 6

GENUS ANOMALINA D'ORBIGNY

Anomalina grosserugosa (Gümbel)

1 Thin section, cut edgewise, x 116. (Slide 1)

2 Entire specimen, x 40-50. *a*, superior aspect; *b*, peripheral aspect. (After Brady, Chal. Rep't, v. 9, 1884, pl. 94, figs. 4*a*, *c*)

GENUS PULVINULINA PARKER & JONES

Pulvinulina boueana (d'Orbigny)

3 Thin section, x 232. (Slide 1)

4 Entire specimen; length 1 mm, breadth 0.87 mm, thickness 0.42 mm. *a*, superior aspect; *b*, inferior aspect. (After Vadász, Triasforam. aus dem Bakony, 1910, pl. 2, figs. 9*a*, *b*)

Pulvinulina elegans (d'Orbigny)

5 Thin section, transverse, x 174. (Slide 5 (X))

6 Entire specimen, x 50. *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. (After Brady, Parker and Jones, Trans. Zoo. Soc., v. 12, 1888, pl. 46, figs. 2*a*, *b*, *c*)

Pulvinulina micheliniana (d'Orbigny)

7 Thin section, x 174. (Slide 1)

8 Entire specimen, x 50. *a*, superior aspect; *b*, inferior aspect; *c*, peripheral aspect. (After Brady, Parker and Jones, Trans. Zoo. Soc., v. 12, 1888, pl. 46, figs. 10*a*, *b*, *c*)

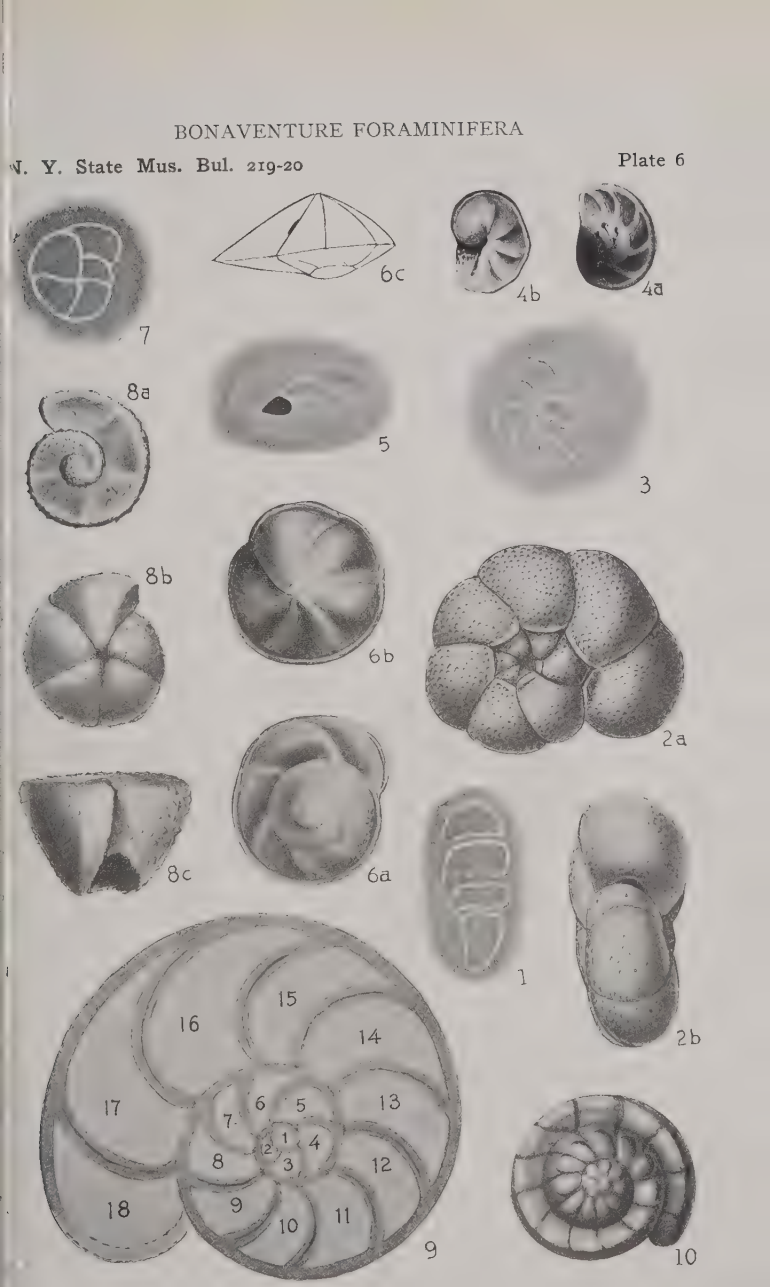
GENUS ROTALIA LAMARCK

Rotalia orbicularis (d'Orbigny)

9 Thin section, x 174, showing interseptal canals which are not seen, or at least not well defined in periphery. (Slide 5 (X))

10 Entire specimen, superior aspect, x 50. (After Brady, Chal. Rep't, v. 9, 1884, pl. 115, fig. 6*a*)

N. Y. State Mus. Bul. 219-20



G. S. Barkentin, del.

A RECURRENT PITTSFORD (SALINA) FAUNA

BY RUDOLF RUEDEMANN

The discovery of a faunule consisting of eurypterids, crustaceans d a few brachiopods and mollusks in black shale intercalated near base of the Salina beds led to the differentiation of these basal ds by Doctor Clarke (1903) as Pittsford shale.

At the same time the overlying " Salina shales " of earlier authors re separated into the Vernon and Camillus shales. These red, en and gray shales with intercalated abundant gypsum beds and ggy dolomites, though reaching a combined thickness of a thousand t, have proved nearly barren of fossils until two years ago when Shelley Crump of Pittsford observed fossils in the Vernon shale ought out of the barge canal at Pittsford, N. Y. He informed of. G. H. Chadwick in Rochester of his discovery, who in turn parted the interesting information to the State Museum.

Two weeks collecting by C. A. Hartnagel and an equal time given work by the writer and his assistants have altogether furnished t twenty-six drawers of material, which proves that fossils are very re even under the extremely favorable condition of collecting from enormous dump pile. The novelty and peculiarity of the faunule, wever, fully repaid for the often discouragingly slow work of collect-g.

The writer made a special effort to get noneurypterid material at would aid in clearing up the question of the habitat of the rypterids which form the dominant element of the fauna and cceeded in finding a small number of brachiopods and mollusks. As in the Pittsford shale, most of the fossils were obtained in the rk gray to black shale bands and the dolomite slabs. There occur, owever, fossils also in the green shale, especially ostracods, and very rely eurypterids; and Professor Chadwick informs me that he has so found ostracods in the red shale.

The following is a list of the forms found:

Lingula semina *Ruedemann* c
Lingula *sp.* rr
Rhipidomella *sp.* rr
Atrypa reticularis (*L*) rr
Trochoceras aff. costatum *Hall* rr

*Hexameroceras chadwicki *Ruedemann* rr
Worm-borings cc
Leperditia scalaris *Jones* cc
L. sp. r
Emmelzoe decora *Clarke* r
*Ceratiocaris salina *Ruedemann* cc
C. cf. praecedens *Clarke* rr
Eurypterus pittsfordensis *Sarle* cc
Mixopterus multispinosus (*Clarke & Ruedemann*)
*Hughmilleria phelpsae *Ruedemann* rr
*Pterygotus vernonensis *Ruedemann* rr

The complete list of the Pittsford shale fauna (see Clarke 1901, Sarle 1901, Ruedemann 1916) is:

Lingula semina *Ruedemann* cc
Pterinea poststriata *Ruedemann* cc
Hexameroceras cf. chadwicki *Ruedemann* rr
Orthoceras *sp.* rr
Leperditia scalaris *Jones* cc
Emmelzoe decora *Clarke* r
Pseudoniscus roosevelti *Clarke* rr
Ceratiocaris praecedens *Clarke* rr
Eurypterus pittsfordensis *Sarle* c
Mixopterus multispinosus (*Clarke & Ruedemann*) rr
Hughmilleria socialis *Sarle* c
H. socialis var. robusta *Sarle* rr
Pterygotus monroensis *Sarle* rr

A comparison of these faunules[1] brings out the fact that they are alike in their general aspect and composition. Disregarding the species that are very rare in either of the two formations and therefore might be present in the other, but have failed of observation, the principal difference between the two faunules consists in the common occurrence of Hughmilleria socialis in the Pittsford fauna and its absence in the Vernon fauna where it is replaced by the rare H. phelpsae; and further in the abundance of the minute Ceratiocaris salina in the Vernon shale, which as yet has not been observed in the Pittsford shale. One might therefore well designate the Pittsford shale as the horizon of Hughmil-

[1] The new forms in the Vernon shale are marked with an asterisk. The designations of frequency of occurrence (cc, c, r, rr) are only relative.

ria socialis, and that of this higher shale as that of eratiocaris salina.[1]

The prominence of Hughmilleria in the Pittsford shale, its suppression in the Vernon shale and its entire absence in the Bertie waterlime and in still later eurypterid-faunas are significant facts in regard to the age-determination of the Shawangunk grit fauna. The Shawangunk grit was correlated with the Pittsford shale, when its fauna was discovered and found to contain as its dominant element a Hughmilleria. This conclusion was unavoidable at the time, the genus Hughmilleria then not being known from any other horizon and locality in this country.

The discovery of the Ordovician eurypterid-faunas, described by Clarke and Ruedemann in the *Eurypterida of New York* from the Cormanskill shale and the Schenectady beds, has thrown a different light on the range of Hughmilleria, for in these Ordovician faunas Hughmilleria was found to be a constant and dominant element.

The Hughmillerias of the Pittsford shale and Shawangunk grit, not being specifically identical can therefore no longer be considered as demonstrating the taxonomic equivalency of these beds. The Hughmillerias of the Pittsford shale, Vernon shale and Shawangunk grit are clearly the last stragglers of a once flourishing race and, as such, of less stratigraphic significance than they would be otherwise. But the whole their occurrence in a Silurian horizon would indicate an age earlier than the Bertie waterlime and a relative dominancy of species of Hughmilleria would point to a comparatively early Silurian age.

NOTES ON THE FOSSILS OF THE VERNON SHALE

Hexameroceras chadwicki nov.

Plate 3, figures 7–9

Professor Sarle (1903, p. 1085) cited from the Pittsford shale a "pentalabiate Gomphoceras." The specimen to which Professor Sarle had reference is now in the State Museum and consists of a living chamber with poorly preserved aperture, leaving it undecided whether the form belongs to Pentameroceras or Hexameroceras (see Ruedemann, 1916, pl. 27, fig. 1).

The Vernon shale has afforded a specimen, here figured, that in size and outline agrees with the fragment from the Pittsford shale and

[1] As pointed out to me by Mr Hartnagel, it is of interest to note that the occurrence of this fauna is near the western terminus of the red Salina shales. This may explain the fact that the development of the Vernon at Pittsford is not quite typical and also account for the presence of a higher intercalation of dark siliferous shale.

probably belongs to the same species; and that at the same tim exhibits a well-preserved aperture leaving no doubt of its prope generic reference to Hexameroceras. We will therefore describe i and we take pleasure in naming it after Professor Chadwick wh kindly informed us of the opportunity of collecting in the Verno shale at Pittsford.

The holotype of the species consists of a living chamber, ver much compressed in the axial direction of the cephalopod, bu apparently undisturbed in transverse direction.

The section was oval, with the dorsal and ventral extremitie slightly produced and acute, the ventral one more so than the dorsal The dorso-ventral axis measures 45.5 mm at the widest part; th minor axis 37.5 mm. The length of the much compressed livin chamber is about 15 mm. The aperture is 20.5 mm at its wides (dorsal) extremity and about 31 mm long. It consists of six dee brachial sinuses, three on each side, and one median sinus on the ven tral side. The sinuses decrease in size toward the ventral side, s that at the third pair the aperture is but 11 mm wide. The dorsa brachial sinuses are the deepest; they and the following pair ar perpendicular to the axis of the aperture, while the third, smalles pair is oblique to the axis. The median sinus is small and continue into the hyponomic slit leading into the hyponomic sinus, which wa at the ventral extremity of the shell, but is not fully preserved.

The siphuncle which is seen on the underside of this specimen, i marginal on the ventral side, and about 7 mm wide.

Two camerae preserved under the living chamber suggest a low narrow saddle on the ventral side and a broad, low saddle on th dorsal side.

A second, smaller specimen (plate 3, figure 9) is compressed laterally and serves to show the shortness of the living chamber which is 16.5 mm long and 30 mm wide. The camerae are very shallow in depth, about one-twelfth of the greatest width, and th septa seem to have been equally shallow.

Horizon and locality. Vernon and Pittsford shale at Pittsford N. Y.

Mixopterus multispinosus (Clarke and Ruedemann)

Plate 1, figures 3–7; plate 2, figures 1–4; plate 3, figures 4–6

Clarke and Ruedemann (1912, p. 297) have described as Stylonurus (Ctenopterus) multispinosus a species of eurypterid from the Pittsford shale, that was based on two walking legs and a sternite. The longer one of the walking

legs, through its series of fine, long, slender spines on the fourth joint, appeared to us as a typical representative of the subgenus Ctenopterus of Stylonurus, no such longitudinal series having then been observed in any other Eurypterid genus except Ctenopterus and the Ordovician Echinognathus. In the latter of these, however, the spines are differently shaped and form a contiguous series, and the endognathite is not slender but short and compact.

To our surprise, the collecting in the Vernon shale furnished specimens that combine this Ctenopterus leg with the body of an Eusarcus, as far as outline of carapace, position of eyes, form of metastoma, predominant length of second pair of endognathites, shape of swimming legs, surface sculpture and curved telson spine are concerned. On the other hand, the preabdomen is not much broader than the posterior edge of the carapace and not at all broadly subcircular, as in Eusarcus; and gradually contracting into the postabdomen, in this regard again recalling Stylonurus. It is thus obvious that this form combines, in a curious way, characteristic features of Eusarcus with certain characters of Stylonurus.

A character apparently foreign to both Stylonurus and Eusarcus is the development of two longitudinal furrows on the tergites of the postabdomen, which separate the flat lateral portions of the tergites from the convex axial part and give the abdomen a trilobed aspect. This feature had already been observed by F. Schmidt (1904) in his Stylonurus simonsoni and described as "Dorsalfurchen." Clarke and Ruedemann (1912, p. 231) have later placed this species of the Baltic Silurian with Eusarcus and it is quite probable that it is congeneric with our multispinosus.

The generic term Mixopterus[1] is here proposed for forms which, like the genotype M. multispinosus, unite the following characters of Eusarcus, namely: subtriangular carapace; forward submarginal position of compound eyes, subtriangular form of metastoma, predominant length of second pair of endognathites and decreasing length of following endognathites, powerful swimming legs with long blade and short proximal joints, and curved telson spine, with the following characters of Stylonurus (subg. 1, Ctenopterus), namely: a relatively narrow preabdomen, and gradually contracting postabdomen, and a series of longitudinally arranged vertically attached spines upon the longer endognathites. A feature *sui generis* in this genus are the "dorsal furrows" upon the preabdomen.

[1] From Greek Μῖξις, a mingling.

We are now also enabled to give a full description of the species M. multispinosus (Clarke and Ruedemann).

Description. Body of small size, ovate-lanceolate in form, a little more than three times as long as wide, broadest at one-third of its length, moderately convex.

Cephalothorax fairly large, occupying about one-fifth of the length of the body. Carapace trapezoidal in outline, about one-fifth wider than long (excluding the frontal process), widest at base and contracting to about five-sixths of its basal width by slightly converging, somewhat concave lateral margins. Antero-lateral angles well rounded; anterior margin extended into a rectangular snoutlike process, about two-sevenths the anterior width of the carapace and twice as wide as long. Its anterior margin is straight. The compound eyes are small, but prominent, suboval in outline, situated at the frontal margin, just outside the base of the protruding anterior process. The ocelli are situated on a prominent circular mound, placed one-third of the length of the carapace (excluding anterior process) from the frontal margin.

Abdomen. The abdomen is ovate-fusiform in outline; the preabdomen about as long as wide, gradually widening to the fourth tergite; its greatest width surpassing that of the cephalothorax by only two-ninths; thence contracting more abruptly to the postabdomen, which is slender conical, contracting in the first three segments preserved to three-fifths of its original width. The tergites are broad, short plates, the largest one is five times as broad as long; the " dorsal furrows " are placed a little less than one-fourth the width from the lateral margin. The sternites are relatively a little longer than the tergites; the operculum about four times as wide as long. The female opercular appendage is shaped as in Eusarcus scorpionis, extending to the middle of the postopercular plate and terminating in two acute lobes.

The telson is a slender spine, curved as in Eusarcus scorpionis; and, as in that species, its basal portion is swollen globularly on the ventral side.

Appendages. Of the appendages of the cephalothorax, parts of the walking and swimming legs, and the metastoma are preserved. The type of the species consists of a fairly slender, first endognathite, and the extremely long, powerful, second endognathite. The more complete specimens from the Vernon shale, here figured, show these two and also sufficient portions of the third and fourth endognathites, to leave no doubt that the latter were considerably shorter and thinner than the second pair of endognathites. Plate 3, figure 5, represents

a separate endognathite which distinctly shows the massive proximal joints and the extremely slender, long, curved spines, five or more of which are arranged in longitudinal series on each joint. The swimming leg is as in Eusarcus scorpionis, that is, of massive proportions and furnished with a large paddle. The first to sixth segments of the swimming leg are short, stout and provided with finely interlocking articulations.

The metastoma is subtriangular, heart-shaped, its width but little smaller than its length. The frontal margin is emarginate, the posterior part produced into a blunt lobe in a young specimen. (See pl. 1, fig. 6)

Ornamentation. The ornamentation consists on most parts of the body of extremely minute granules; on some parts, as the edge of the metastoma and the postabdomen, especially in larger specimens, the granules develop into distinct disklike or lunate scales, like those of Eusarcus scorpionis, and sometimes into elliptic, dropliike scales as in Echinognathus.

Measurements. The most perfect specimen has a carapace 27 mm long and 35 mm wide at the base and 27.5 mm wide in front. The greatest width of the preabdomen in this specimen is 44 mm, the length of five tergites 40.5 mm. The compound eyes are 3 mm long. In another specimen where the preabdomen is 38 mm wide, the anterior end of the postabdomen is 24 mm wide and the posterior end of the third postabdominal segment 10.5 mm.

There is no doubt that Mixopterus multispinosus reached a much greater length than the two bodies here figured, for the second endognathite, which is the type of the species, is three times as long as the corresponding part attached to the original of plate 1, figure 3, and we have before us a telson-spine, 23 mm wide at the anterior end and originally at least 1 dm long. This would indicate a specimen at least 4 dm, or considerably more than a foot long.

Horizon and locality. Vernon and Pittsford shale at Pittsford, Monroe county, N. Y.

Remarks. M. multispinosus has the snoutlike frontal process of the carapace in common with Eusarcus vaningeni Clarke and Ruedemann, E. cicerops (Clarke) and the Ordovician types, E. nasutus and linguatus Clarke and Ruedemann. Of E. cicerops, specimens have been observed since the publication of the *Eurypterida of New York*, that show the frontal process much more pronounced than those figured in that work. Although two specimens of E. vaningeni were found with the

tonguelike extension bent more or less downward, it was then argued (op. cit., p. 420) that this was probably not the normal position of the lobe.

The carapace of Mixopterus multispinosus, however, exhibits a number of features that seem to suggest a different orientation of the process, in this species at least. The tonguelike process is separated from the carapace by a ridge that is in line with the frontal margin of the carapace and it is surrounded by a suture. Its straight frontal and curved lateral margins give the appearance of a lobe cut off, or rather fitting into the marginal shield of the ventral surface of the carapace, and indeed, the specimen, plate 1, figure 3, shows at *a* rounded, protruding lobes of the marginal shield which snugly fit into the sides of the frontal process. Moreover, the frontal margin of the carapace is not straight transversal as the trapezoidal outline would have one expect, but is curved outward in front of the eyes, and this curved outline is continued backward into oblique folds that pass to the postero-lateral corners of the carapace. These folds, together with the preocular projections delimit, however, a perfectly triangular carapace of a typical Eusarus (see diagram, plate 1, figure 4). One can therefore not help feeling that the narrow segments (*b* of diagram) at the antero-lateral corners, which give the carapace in the specimen a trapezoidal outline, are also parts of the head-shield, that were originally bent downward under the shield, and only became flattened out when the ventral integument of the cephalothorax separated from the carapace along the lateral suture, perhaps in moulting. In the specimen, here figured, it is proved to have become separated by having become subsequently displaced and pushed forward of the carapace.

As in Eusarcus vaningeni, concentric wrinkles upon the middle portion of the carapace indicate that this part was considerably elevated and therefore likely to have steeply inclined cheeks with reversed curvature in the lower part.

We arrive thus at a structure of the ventral side, corresponding to that observed in Hughmilleria (see Clarke and Ruedemann, p. 428) where an epistoma and two flanking antelateral shields have been observed as integral parts of the marginal shield of the ventral side. In that genus, however, these plates have become separated by sutures from the carapace and the remainder of the ventral integument.

Worthy of special notice is the clasping organ of the male (see plate 1, figure 3) observed attached to the first endognathite in the most complete specimen. It appears as a fairly large (3 mm long)

ckle-shaped, thin walled (originally hollow) process from the middle
the third (?) joint of the first pair of endognathites. It is the first
me, to my knowledge, that this organ has been observed in any
merican eurypterid. Holm had before recognized this hcoklike
ppendage in Eurypterus fischeri, where it is attached to
ne fifth segment of the second endognathite (see Clarke and Ruede-
ann, p. 157), and by analogy with Limulus, considered it as a clasp-
ig organ.

Hughmilleria phelpsae nov.

Plate 3, figures 1-3

The Vernon shale has furnished two specimens of a Hughmilleria
iat proved distinct from H. socialis Sarle of the underlying
ittsford shale.

The specimens consist only of carapaces, attached to which are
veral of the anterior tergites and in one case also the operculum
id female opercular appendage. We shall therefore merely point
it the differences from the completely known H. socialis that
e apparent in these fragments.

The carapace is relatively broader and shorter in this species;
hile in H. socialis length and width are about equal, the width
here greater by one-fifth to one-fourth. In the type (plate 3,
gure 2), the width is 10 mm, but the length only 8 mm. In the
her larger specimen, the two dimensions are 18 mm and 13 mm
spectively.

The compound eyes are not marginal as in H. socialis but
stant from the margin about one-half the length of the eye.

The surface sculpture consists on the carapace of five parallel lines
ong the frontal margin, irregularly distributed, small tubercles on
ie posterior portion of the carapace and a fringe of fine triangular
ales along the posterior margin. The tergites bear three to four
rallel lines along the posterior margin, which posteriorly are
llowed by five scalloped lines which finally break up into series of
int, separate, lunate scales. In the larger specimen there are seen
ar the posterior margin of the second tergite traces of larger prom-
ent triangular scales. The operculum bears imbricating angular
ales as in H. socialis.

The opercular appendage is longer than that of H. socialis and
steriorly expanded. Likewise is the appendage of the following
ernite expanded at its extremity.

While H. phelpsae is clearly distinct from H. socialis
the characters here pointed out, it has these in common with

H. shawangunk Clarke, which not only possesses a like relatively broad carapace and equally inwardly placed compound eyes, but also the same linear sculpture on the front of the carapace and of the tergites. While, however, in H. shawangunk this linear sculpture is also carried to the ventral side (see Clarke and Ruedemann, pl. 66, fig. 7), in H. phelpsae the ventral side possesses the angular imbricating scales of H. socialis.

While thus H. phelpsae and H. shawangunk are not identical species as one might surmise at first glance, they are nevertheless much more closely related to each other than are H. phelpsae and H. socialis. This is the more remarkable in view of the fact that H. phelpsae is younger than H. socialis and the related H. shawangunk is, according to some authors (Van Ingen, Schuchert) who would place the Shawangunk grit in the Clinton or upper Medina, still much older than H. socialis. The Vernon species would then appear as a probable late descendant of the earlier Shawangunk form rather than of the closely preceding Pittsford species.

Pterygotus ? vernonensis nov.

Plate 1, figures 1 and 2

The writer has collected two small carapaces in the Vernon shale that are representative, in outline and position of compound eyes, of the Pterygotus group of the eurypterids, but not identical with the Pterygotus monroensis of the Pittsford shale fauna; differing from the latter in being rectangular in shape with a straight transverse frontal margin, while in P. monroensis, judging from the single specimen known, the carapace is semi-elliptic and well rounded in front.

The larger carapace is 10.5 mm wide and 7.5+ mm long, the smaller one (type) is 4.5 mm wide and 4 mm long. The carapace of this form is hence relatively short when compared with that of other congeners. The lateral margins are nearly straight or but slightly sinuous, the frontal margin gently convex and the anterior lateral corners abruptly rounded. The compound eyes are placed in these corners, occupying the projecting points of the latter, and hence, in the larger specimen at least, appearing as narrow truncations of the angle. Median eyes subcentral. Surface in the smaller specimen furnished with fine, closely arranged tubercles on the posterior portion of the carapace; in the larger, with short, oblique parallel lines along the lateral margin.

These carapaces, in their subrectangular outline and position of ne compound eyes in the anterior corners, suggest relationship to ne peculiar British genus Slimonia. Similar squarish carapaces ith a like position of the compound eyes in the corners have, owever, already been described by Clarke and Ruedemann from ne Ordovician rocks of New York and have not been found accom- anied by other parts of the body indicative of relationship to limonia, such as the telson, and walking legs. It is therefore nought that these carapaces merely belong to a group of Pterygotus possible subgeneric rank, to be segregated with more complete naterial.

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EXPLANATION OF PLATES

Plate 1

Pterygotus ? vernonensis nov.

Fig. 1 Carapace, natural size

Fig. 2 Carapace (type specimen) x 3

Mixopterus multispinosus (Clarke & Ruedemann)

See plate 2, figures 1-4; plate 3, figures 5, 6

Fig. 3 Dorsal view of most complete specimen found, seen from the interior. Natural size

a Anterior lobe of marginal shield of ventral integument

b Antero-lateral lobe of carapace

c Second endognathite

d Clasping organ in place

Fig. 4 Diagram showing relative position of lobes of dorsal (*b*) and ventral sides (*a*) of carapace. The portion of the carapace exposed on dorsal side is shaded

Fig. 5 Telson spine. Natural size

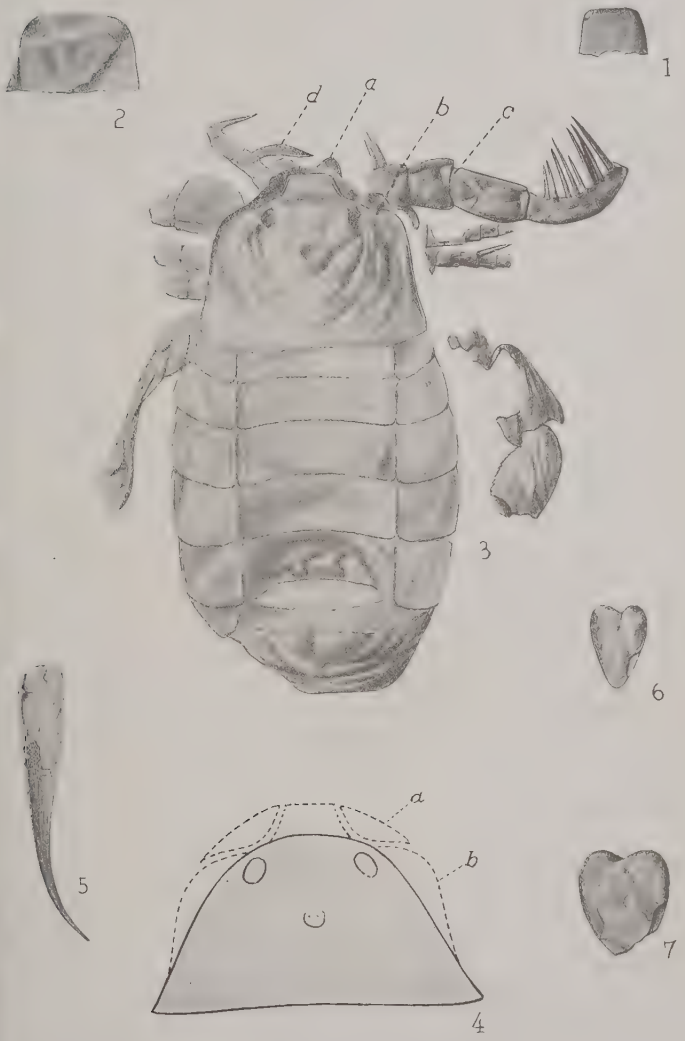
Figs. 6, 7 Metastomas. Natural size

The originals are from the Vernon shale at Pittsford, N. Y., and are in the New York State Museum.

SILURIAN (VERNON SHALE) FOSSILS

Pittsford Fauna

N. Y. State Mus. Bul. 219–20 Plate 1



G. S. Barkentin, **del.**

Plate 2

Mixopterus multispinosus (Clarke & Ruedemann)

See plate 1, figures 3-7; plate 3, figures 5, 6

Fig. 1 Dorsal aspect of specimen retaining the preabdomen and three segments of the postabdomen, as well as a fragmen of the second endognathite. Natural size, taken from mol

Fig. 2 Ventral view of same specimen

Fig. 3 Dorsal view of abdomen, showing well the "dorsal furrows"

Fig. 4 Opercular appendage (of original of figure 2). x 3

Originals from Vernon shale at Pittsford, N. Y., and now in th New York State Museum.

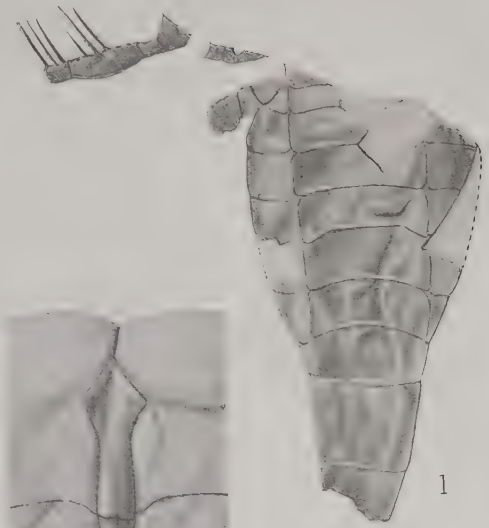

1
2
3
4

Plate 3

221

Hughmilleria phelpsae nov.

Fig. 1 Specimen (cotype) retaining part of carapace, two tergites and operculum with opercular appendage. Natural size

Fig. 2 Type of species, consisting of carapace and two tergites. x 3

Fig. 3 Enlargement (10 x) of sculpture of tergite

Mixopterus multispinosus (Clarke & Ruedemann)

See plate 1, figures 3-7; plate 2, figures 1-4

Fig. 4 Postabdominal segment. Natural size

Fig. 5 Endognathite. Natural size

Fig. 6 Nearly complete swimming leg. Natural size

Hexameroceras chadwicki nov.

Figs. 7, 8 Two views of type specimen. Natural size

Fig. 9 Lateral view of cotype, showing length of living chamber and depth of air-chambers. Natural size

The originals are from the Vernon shale at Pittsford, N. Y., and are now in the New York State Museum.

SILURIAN (VERNON SHALE) FOSSILS

Pittsford Fauna

N. Y. State Mus. Bul. 219–20

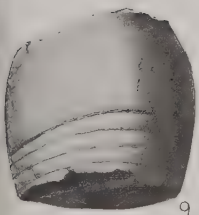
Plate 3

1

2

3

7



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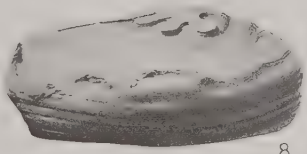

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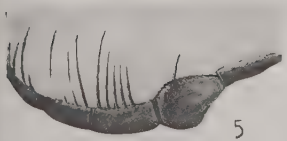

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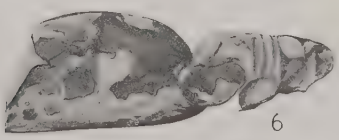

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G. S. Barkentin, del.

THE RECONSTRUCTION OF THE STERLINGBUSH CALCITE CAVE

BY NOAH T. CLARKE

It may be of interest to museum workers with their many problems in common, to know something of the story of this remarkable grotto now housed in the State Museum.

Several years ago in a quarry at Sterlingbush, Lewis county, N. Y., an opening of some 4 feet in diameter was revealed after blasting. This opening proved to be a puncture in the wall of a grotto which broadened out to 10 feet in width and 5 feet in height and extended back for 20 feet to a narrow vault of 4 feet in diameter, continuing on a gradual slope downward for 20 feet more and terminating in an inaccessible and almost perpendicular crevice. Realizing that in the course of quarrying operations the crystal contents of this grotto must be destroyed, it was decided to remove them to a place of permanence where the public might have access to an exhibit as near like the original as practicable. On account of the size of the crystals the task of removal and safe shipment of some 14 tons was a tremendous undertaking. Some of them weighed as much as a thousand pounds and each, whether large or small, was a perfect geometric development of calcium carbonate delicately colored by manganese to an amethyst in reflected light and pink in transmitted light.

The problem of reconstruction was ahead and careful detailed study of the project had to be assumed and worked out by those skilled in many arts. A blind closet about 8 feet square beneath an arch in the mineral hall seemed a likely place for such an exhibit but the difficulty in this was to obtain in such a small space the depth required by the original cave. After much experiment it was found that by placing upright a plate glass mirror 18 by 24 inches at the farthest left-hand corner of the closet and at an angle of 46° to the observer and also a second mirror 14 by 34 inches, tipped back slightly and hidden from view in a proposed recess on the right directly opposite the first mirror, we could produce an apparent depth of 25 feet and a gradual slope down to a narrow passage, as in

the original. With this arrangement the spectator could not see his own image or the ordinary visitor detect a mirror.

The iron frame work which was to support the weight of the crystals was built of $1\frac{1}{4}$ inch angle iron and in order to relieve the great strain on the museum floor suspended from a roof girder by a seven-eighths inch iron rod with a turnbuckle.

The form of this frame was determined by making a full-size ground plan of the closet and by bending thin strips of wood into the shape of the intended iron ribs. There were fifteen of these ribs which met at the center of the roof and were bolted in place to a large circular iron plate. The general shape of the completed framework was that of an irregular dome with a false floor built of 2 inch angle iron 20 inches above that of the museum floor. The object of this was to place the visitor in a more intimate relation to the exhibit by bringing the crystals into greater prominence. An opening $2\frac{1}{2}$ feet square was provided in the front of the iron work to allow for a window for the observer.

Our attention was devoted for nearly two months to preparing the crystals for exhibit and working out a method to fasten them to the walls and roof. There was a secondary or stalactitic formation over many of the crystals which was removed by applying dilute hydrochloric acid with a jeweler's brush, always exercising great care in order to confine the acid to the particular spots where there was crust, so as not to injure the fine sharpness of the angles and the exposed faces of the clear crystals.

To suspend calcite in large and bulky crystals from the ceiling and in every conceivable position at any angle was the proposition now before us. If one has had the experience of drilling a fine calcite crystal and had it fly into a half dozen pieces he can imagine the discouragement of having several hundred crystals before him to be drilled accurately, some to have three and four holes each. This was exactly the problem. We devised an individual clamp which would have held the weight of the crystal but to make a special clamp for each separate specimen would have been impracticable on account of the area of crystal faces concealed and the expense and time required to make them. Further experimenting with flat drills nine thirty-seconds of an inch and seven thirty-seconds of an inch diameter of Stubb's English steel, hardened in water and drawn to a straw color, used in a lathe turning at a slow speed of about 400 revolutions a minute, proved to be a successful method to obtain results. This way we were able to obtain a steady motion and apply

a gradual and even pressure, so essential in overcoming the difficulty of boring through many cleavage planes which were always a constant source of trouble. With this procedure, out of all the lot, just two crystals failed us. Thin slabs composed of clusters of small crystals were drilled entirely through. An iron bolt with a loop at one end was fastened in these holes by means of a nut and washer on both the face and back of the specimen. The exposed nut on the face of these clusters was easily hidden by matching a small crystal over it. The larger specimens, however, were bored for a depth of only 2 inches and in each hole was set a $1\frac{7}{8}$ inch screw eye; the heaviest crystals necessitating special heavy irons of the same shape. By pouring melted sulphur in the hole and immediately plunging into it a red hot screw eye, we had a means of support, when cold, by which the crystals could be wired in any position to the iron framework. Many times the distance between the iron ribs was too great and necessitated spanning these spaces with three-fourths inch or $1\frac{1}{4}$ inch band iron.

The actual placing in position of the crystals was started at the deepest point, which was around the mirror. Small areas of the frame were covered as needed with galvanized iron wire screen of one-fourth inch mesh. After a crystal had been securely wired to the framework, a combination of cheese cloth and plaster woven over the wires and frame between the screen and crystal held it permanently in the exact position desired. This same process was continued gradually around the sides and roof to the window.

Each time a crystal was placed there were three points to consider: Did it fit exactly to the one next to it? Were the best crystal faces seen, not only looking directly at it but in each of the two mirrors? Was it possible to place behind it an electric light which could not be seen from three sides? These questions arose simultaneously nearly every time and the solution was simply the answer given by trying out each of them.

The construction of the floor was the last and comparatively the easiest operation. Two-inch spruce planking was laid over the floor girders to carry this great weight as the largest crystals of the original cave were found on the bottom, many of them entirely free on all sides and apparently with no surface of attachment. For this reason it was not necessary to place these so close together, which gave a good deal of leeway for electric lights with shades.

We have carefully shaded a system of twenty-one lights ranging from 10 to 60 Watt, which have been placed behind the most highly

colored crystals. The astonishing effect of glowing soft colors by so transmitting the light could not be achieved in any other way and although this condition could not be found in nature, the aid of a little itensified light certainly brings out and emphasizes the exquisite beauty which would otherwise lie dormant or be lost.

INSECTS AND THE STATE

BY E. P. FELT

Insects outrank all other animals in both number and variety of orm and exert a vastly greater influence upon human welfare than nost realize.

They feed upon and destroy our garden and farm crops, they eriously injure both fruit and trees of the orchard, they defoliate and ain shade trees, strip the leaves from forests or tunnel the wood and nus greatly lessen the value of forest products, through annoyance nd irritation of domestic animals they greatly reduce the amount nd value of dairy products, they establish themselves in dwellings nd not only defile and destroy food but are important and in some ases the sole agents in spreading such deadly infections as typhoid ver, typhus fever, yellow fever, malaria and bubonic plague, to ention some of the most important. The loss of agricultural oducts caused by insects in the United States has been estimated at billion dollars annually and in New York State it amounts to at ast fifty million dollars a year. It is only necessary in this connec- on to mention the codling moth of the orchard, the Hessian fly of ie wheat field, the boll worm of the cotton field and our latest ldition, the European corn borer, an insect which threatens enor- ous losses throughout the extensive corn-growing areas of the nited States. A considerable proportion of this waste can be oided by the adoption of preventive and remedial measures.

A primary requisite for the prevention of losses caused by insects a knowledge of our fauna because recognition and differentiation ust precede fruitful investigation of habits and biology, which tter is necessary to the most effective control.

There are actually more species or kinds of insects than of all other rms of animal life. The number in the world has been estimated various authorities at from one to ten million. We have in the ate of New York some twenty thousand different species, each resented by at least four well-marked stages, namely, the egg, the va, variously known as the maggot, grub or caterpillar, the pupa chrysalis and the perfect insect or adult. Not a few show well- fined differences between the sexes as well as in the various larval ges, and it is therefore no exaggeration to state that we have about

one hundred thousand different forms or stages — all liable to attr notice and not a few capable of inflicting serious losses in one way another, and for this reason legitimate subjects of inquiry a investigation.

The richness and variety of insect life is illustrated in the st exhibit collection by the brilliantly colored bird butterflies, some w a wing spread of over six inches and others noteworthy because their gorgeous purple, green, blue and golden hues, while the gro of Morphos shows a brilliant iridescence equaling that of the gay humming birds and unrivaled elsewhere in nature. There is also dull-colored bird-sized Brazilian moth with a wing spread of n inches, the giant grasshopper of Panama with its wings spann eight inches and the tropical walking stick with a stretch of sixt inches from the tip of the forelegs to the posterior extremity of body. The giant rhinoceros beetle, relatively elephantine in p portion, measures six inches from tip to tip, while a large wo boring beetle has feelers or antennae eight inches long. These marked exceptions and present strong contrasts to the small mot perfect in every way, frequently exquisitely colored, and with a w spread of only one-fourth of an inch or less, or the tiny gall midg some with a length of less than one-fiftieth of an inch.

The exhibit collection with its ten thousand specimens sugge the size of the state collection with its 170,000 specimens, accessi to students and representing all the well-known insects and those many groups, which ordinarily escape attention. They have be assembled during a period of forty years and are invaluable not o because of the numerous species represented but on account of many associated records, the latter permitting one to turn to collection and read with its assistance of early abundance and inju There are large series of insects so minute or fragile that they must mounted on glass slides before they can be studied and over ten th sand such preparations, indestructible as the amber embed insects of geologic time, give some idea of the enormous amount labor necessary to create such a collection. We have in this la assemblage nearly two thousand specimens of grasshoppers and th allies, about one thousand of the large and handsome dragon fl over twelve thousand true bugs, over thirty thousand butt flies and moths, probably as many if not more flies of vari kinds, many very minute, over forty thousand beetles and se ten thousand bees, wasps and their associates. The above figu include two notable collections, namely that of the late W. W. H of Albany, comprising some ten thousand specimens of butter

and moths, and the J. A. Lintner collection of nearly twenty thousand specimens of all kinds of insects.

Some years ago the state collection of insects was valued at $50,000. This is a nominal sum and it is quite certain that the material could not be duplicated for that amount. A pair of bird butterflies on exhibition cost $20 and four large beetles $15. While these prices are exceptional, it is true that a very large proportion of the specimens can not be purchased and practically none with the records of so much value to the economic entomologist can be secured through commercial agencies. There are in addition, one thousand types, uniques, which have been described by various entomologists and are held as well-nigh priceless, since they are the final court of appeal in case of a question as to the identity of an insect.

We also have besides specimens of insects themselves, examples of their work, such as a large series of plant galls showing myriad and in many cases very striking developments of plant tissues, the characteristic work of various pests in the products of the farm and the remarkable borings of many wood-inhabiting species, these latter frequently leaving behind them permanent records which not only permit the identification of the insect but the recognition of the wood and even make it possible to determine the condition of the tree at the time it was attacked.

This collection, aside from being representative of a very important part of the animal life of the State, is literally a portion of the entomologist's working library and is as essential, in many cases more so, than the printed page, and no less necessary than the special library is to the lawyer, doctor or other professional man. It might be regarded as a series of volumes with a total of 100,000 pages, each devoted to one stage of an insect or its work, and were this examined critically, misplaced or illegible pages would be found. It is a manuscript, as it were, rivaling in complexity those ancient rolls of the Egyptians, exceeding in bulk many good sized libraries, demanding special training for its correct interpretation and making incessant demands upon custodians for repairs, replacements and additions. It is still far from complete and years must pass before all stages of our many insects and examples of their activity are adequately represented in the New York State Museum.

The lessons we may learn from nature profoundly affect our well-being. There is no better introduction to an appreciation of the wonders about us than through insects. They occur almost everywhere. Each group has its own characteristics and not a few exhibit marvelous adaptations to conditions. There are the social insects

with complex societies and peculiar enemies and parasites, the gal insects with their alternation of generations and exceedingly clos relation to plant life, the entire group of predaceous and parasiti forms living at the expense of other insects, the comparatively helples plant lice or aphids overcoming hereditary weakness by a wonderfu prolificacy and an alternation of food plants, not to mention th marked and in many instances easily observed transformations o individual species. Insects should have an important place in ever course in biology or zoology.

Many insects are of more or less direct service to man, notably th honey bee, the silk worm, the lac insect, the cochineal insect and certain blister beetles. There are also the numerous bees, wasps and flies, mostly disregarded, which carry pollen from plant to plant and are essential aids in the production of our more valuable fruits. They render a service commonly accepted with no realization of its great value. Other beneficial functions are suggested in the preceding paragraph.

It will be seen at once that some insects are beneficial, a considerable series injurious and that hosts of others may become destructive through minor changes in climate, cropping or as a result of becoming established in new areas. Over half of our principal agricultural pests are importations from other countries. These conditions suggest the need of a comprehensive knowledge of the entire insect fauna, not only of this State, but of adjacent states and also of countries with which we have close commercial relations, if the subsequent developments in an exceedingly complex group are to be appraised correctly and the possibilities of loss reduced to a minimum. Nursery inspection and quarantines are practical measures designed to reduce the danger from the introduction of insects from other countries. Entomologists are constantly being called upon to pass on the probabilities of injury by insects of many species and occurring under most diverse conditions. They are really entomological engineers compelled by circumstances to acquaint themselves with an enormous amount of detail and at the same time remain masters of comprehensive information concerning a wide range of subjects.

The natural resources of the State have long been recognized as legitimate objects for investigation. There is no one group of living organisms occurring in such great variety or such large numbers as insects and for them we may also claim a most material effect upon human welfare and prosperity. If the above be granted, and there is no escape from such a conclusion, it logically follows that we should

know something about this vast assemblage with its multifarious possibilities for good or evil, and since recognition and differentiation are essential to intelligent study, the assemblage and classification of immense series must necessarily precede economical and effective investigations, whether the latter be taxonomic, biologic or essentially economic. An extensive, well-classified collection is fundamental and the importance of this phase of the work should not be underestimated in any comprehensive scheme for an entomological survey of the State such as is really now in progress, though not ordinarily characterized as such.

The occasional outbreaks of previously almost unknown or obscure insects illustrate in a convincing manner the need of studying some of the comparatively unknown or neglected groups if we would be in the best possible position to meet future emergencies. The discovery last winter of larvae of the European corn borer in New York State brought us face to face with the real difficulty of distinguishing between the caterpillar of this pest and that of an allied native, comparatively innocuous form and this, in spite of the fact that the genus Pyrausta, to which the European corn borer belongs, has been considered as of little or no economic importance in the new world. Similar situations may arise in the future and no man can predict the difficult combinations entomologists may be expected to solve in the near future. The complex problems of adaptation to food plant, to climate and soil, hinted at above, necessitate the extension of investigations into realms not ordinarily considered entomological, though with a very definite bearing upon questions of control or probable injury.

A program in relation to the insects of the State of New York which fails to take into account these various factors and which does not provide for the adequate prosecution of the fundamental taxonomic and physiologic problems as well as the investigations of more immediate application, means the attempted direction of a very important line of work under a serious handicap and almost inevitable, though easily preventable, losses greatly in excess of the cost of such studies and investigations.

NOTES ON FUNGI, VI

BY HOMER D. HOUSE

Mycena filopes (Bull.) Quelet

(Champ. Jura Vosg. 72. 1872)

Figure 1

garicus filopes Bull. Herb. Fr., pl. 320. 1786.

Plants gregarious, 8–11 c. high; pileus 8–15 mm broad, 6–10 mm gh, campanulate, not fully expanded, sometimes subumbonate hen young, in color varying from very dark bister to almost lackish with the narrow lighter colored margin often nearly white, ark gray with age with a darker center, rarely with a whitish round ot in the center and the margin pale gray, sometimes the entire ileus with a dull yellowish tint in addition to the colors already oted, striate, thin; stems 1–2 mm thick, straight or flexuose, oncolorous, darker toward the base, white above, fistulose, radicat- ig and strigose hairy toward the base and very minutely pruinose t the apex; lamellae adnate, uncinate, subdistant, interveined, bventricose, white, sometimes with a pink reflection, edge even r slightly eroded; cystidia none on the sides of the lamellae or ery rare, edge of the lamellae with stout, clavate sterile cells (or ystidia) with numerous short, blunt projections on the ends, 35–45 x 0–12 μ; basidia two-spored; spores subelliptical, curved and ointed at the base, smooth or granular, 6–11 x 3.5–4.5 μ.

On decayed bits of wood and leaves under trees of Pinus igida. Karner, Albany county. H. D. House and G. F. tkinson, November 1, 1918. (Herbarium N. Y. State Museum nd Herbarium Atkinson, no. 24409.) The identification of this ith the common European species was made by Professor Atkinson, nly after a most careful comparison with authentic European aterial. In the nomenclature of the North American flora, this ould be designated as Prunullus filopes (Bull.) House, omb. nov.

Mycena atkinsoni sp. nov.

Figure 2

Plants gregarious, ow, subcaespitose, 5–7 cm high; pileus 1–2.5 m broad, stems 2–3 mm thick and stout. Pileus campanulate- xpanded subumbonate, smoky to avellaneous, distinctly depressed

striate; gills adnate, uncinate, ventricose, distinct, interveined white when young, becoming gray or dark gray; cystidia none o at least very rare on the sides of the lamellae and when presen very inconspicuous, abundant on the edges of the lamellae, large than the basidia and with several short blunt projections over th free end; spores suboval to short elliptical, rounded at both ends smooth, 8–9 x 6–7 μ. Stem even, radicating, concolorous, dar avellaneous to tawny, chestnut below, smooth, hollow. Odor an taste of the pileus not distinctive.

On buried wood, low ground among leaves and moss. McKown' grove, near Albany. H. D. House and G. F. Atkinson, November 2 1918. (Herbarium N. Y. State Mus. and Herbarium Atkinson no. 24407.) In the generic nomenclature of the North America flora this would be designated as Prunullus atkinsoni

Lophiotrema peckiana (Sacc.) comb. nov.

Lophiostoma sexnucleata Peck, 27th Rep't N. Y. State Mus. 11 1877. Not Cooke.

Lophiotrema sexnucleata var. peckiana Sacc. Syll., 2: 68 1883.

On dead stems and branches of Vitis, North Greenbush, N. Y. (C. H. Peck), October 1873. This is quite distinct from typica specimens of L. sexnucleata, in the more approximat perithecia and the much smaller size of the spores.

Rhizopogon rubescens Tul.

Karner, Albany county. C. H. Peck (det. C. W. Dodge).

Rhizopogon luteolus Tul.

Westport, N. Y. C. H. Peck (det. C. W. Dodge).

Helminthosporium pedunculatum (Peck) comb. nov.

Clasterosporium pedunculatum Peck, Ann. Rep't N. Y. Stat Mus. 25: 93. 1873.

Helminthosporium attenuatum Peck & Cooke; Sacc. Syll. 4: 417. 1886.

On the surface of decayed wood, Savannah. C. H. Peck. O decayed wood of Acer rubrum, Verona, Oneida co. C. H Peck.

Fig. 1 Mycena filopes (Bull.) Quelet

Gloniopsis gloniopsis (Gerard) comb. nov.

Hysterium gloniopsis Gerard, 6: 78. 1876.
Gloniopsis gerardiana Sacc. Syll., 2: 774. 1883.

On oak, New Jersey (Ellis, no. 2083). The specimen in the N. Y. State herbarium is on the bark of Quercus (oak).

Mycosyrinx osmundae Peck

(Ustilago osmundae *Peck*)

Pecksport, Madison county. H. D. House, July 10, 1918, on Osmunda regalis L. Woods, three miles north of New London, Oneida county. H. D. House, July 18, 1918, on Osmunda cinnamonea L.

Puccinia lobeliae Gerard

Oneida, Madison county, on leaves of Lobelia syphilitica L. August 27, 1918.

Puccinia pyrolae Cooke

(P. polygalae *Paz.*)

Bergen swamp. Genesee county, on leaves of Polygala pauciflora, August 23, 1918.

Uromyces silphii (Burr.) Arthur

West of Oneida (in Oneida county) on Juncus tenuis L. House, 1918. Determined by Dr J. C. Arthur. The aecial stage is supposed to occur upon species of Silphium, which do not occur in this region. Doctor Arthur intimates that in this case Aster macrophyllus might be the alternate host.

Puccinia rhamni (Pers.) Wettst.

Albany, on Festuca elatior (the host determined by Professor Hitchcock). The aecial stage on Rhamnus cathartica, at the same locality. Both hosts are introduced species.

Ustilago bipustulata Peck

Mendon, Monroe county, in the inflorescence of Rhynchospora glomerata. M. S. Baxter 172, September 1910 (Herbarium N. Y. State Mus.)

Uromyces spartinae Farlow, I.

On leaves of Steironema ciliatum, near the mouth of Oneida creek, Madison county, June 17, 1918. The telial stage occurs upon Spartina michauxiana, which, although common about one-eighth of a mile distant, was not growing near the Steironema, and later search failed to find the telial stage. This form has been designated as a race by Arthur under the name of Uromyces steironematis.

Puccinia pustulata (Curt.) Arth.

I On Comandra umbellata, Sandy woods west of Albany, June 10, 1918.

II, III On Andropogon furcatus, at the same place, September 9, 1918

Doctor Peck's collection of August 24, 1908, is on Andropogon scoparius.

Puccinia frax nata (Schw.) Arth.

I On leaves and petioles of Fraxinus americana and F. pennsylvanic, Lewis Point, Madison county, August 20, 1918 (old).

II, III At the same locality and same date on Spartina michauxiana.

Puccinia cephalanthii (Schw.) Arth.

(P. seymouriana *Arth.*)

Further collections of this interesting rust were made at South Bay, Madison county. I On leaves and petioles of Cephalanthus occidentalis L., June, 1918. II, III On leaves of Spartina michauxiana, August 20, 1918.

Puccinia commutata Sydow

(Allodus commutata *Arthur*)

On leaves of Valeriana uliginosa Rydb., Jordanville, Herkimer county. House, July 12, 1918. This constitutes a new host record for this rust, and is the first record of its occurrence in the eastern states.

Puccinia lysimachiae (Schw.) Kern I

On leaves of Lysimachia quadrifolia, near Sylvan Beach, Oneida county. House, July 18, 1918. The telial stage is

Fig. 3 Stereum willeyi (Clinton) Burt

supposed to occur upon Carex limosa and megallanica, neither of which has been found in this vicinity.

Puccinia minutissima Arthur

On leaves of Decodon verticillatus (L.) Ell. at Pecksport, Madison county, July 10, 1918. The telial stage was found on Carex lasiocarpa, August 29, 1918 at the same locality.

Puccinia orbicula Peck & Clinton

Jordanville, Herkimer county on leaves of Nabalus albus. House, July 12, 1918. Doctor Arthur, after an examination of a duplicate specimen, thinks this is P. patruelis (P. hieraciata), an heteroecious rust, and remarks that the spores are somewhat smaller than P. orbiculata and that only pycnia and aecia are present. Doctor Peck collected this on the same host at Cedarville, near Jordanville, and it was determined as orbicula.

Stereum willeyi (Clinton) Burt, comb. nov.

Thelephora willeyi Clinton: Peck in 26th Rep't N. Y. State Mus. 71. 1874.

Figure 3

This interesting fungus has the appearance or habit of a Thelephora, and was so described by Clinton. When young it is pure white, and rather conspicuous; with age it becomes somewhat dingy and slightly zoned, the margin which is nearly or quite entire in young plants becomes laciniately toothed or lobed, often split down one side. Typical plants are infundibuliform, with a thin texture which is neither tough nor brittle, although becoming very brittle upon drying. Neither Peck nor Clinton describes the spores, which are colorless, a character which removes the species from Thelephora to Stereum, as indicated by Professor Burt. The illustration of the plant is from photographs of it taken near Green pond, east of Jamesville, Onondaga county, May 1918. Clinton obtained it near Buffalo, and Peck collected it at Lowville, Lewis county.

Morchella angusticeps Peck

Rich soil in thin woods near Pecksport, Madison county. H. D. House, June 1918.

Polyporus elegans (Bull.) Fries

Green pond, near Jamesville, Onondaga county, on fallen trunk of Tilia. Typical in all respects except the unusually short stipe, which in these specimens measured but 4 to 9 mm in length.

NOTES ON LOCAL FLORAS VI

ALBANY COUNTY

Cares siccata Dewey

Sandy woods west of Albany. H. D. House, June 10, 1918.

Sporobolus vaginiflorus (Torrey) Wood

On barren ledges of shale, Glenmont, Albany county. H. D House, September 17, 1918. Along a sandy road near Karner H. D. House, September 20, 1918.

Dryopteris cristata x spinulosa C. Chr.

Low woods west of Albany. H. D. House, September 20, 1918 Reported also from Rockland, Delaware and Chemung counties.

Lupinus perennis, forma **albiracemus** Moore

West Albany and Menands. C. H. Peck. Also reported from the vicinity of Rochester (Proc. Roch. Acad., 3: 56. 1896).

Polygala paucifolia, forma **alba** (Eights) comb. nov.

P. paucifolia, var. alba Eights, T. & G. Fl. N. Am. 1:132, 1838; Bec Bot. 46. 1833; Torr. Fl. N. Y., 1:152. 1843

P. paucifolia forma albiflora Knight, Rhodora 8: 66. 1843

Common in woods near Glenmont. H. D. House. Mr Eight first recorded this color form from the sandy plains near Albany where it is still frequent. It has since been observed and reported i Broome, Schenectady and Otsego counties.

GENESEE COUNTY

Scirpus cyperinus (L.) Kunth, var. **pelius** Fernald

Bergen swamp, Genesee county. H. D. House, August 23, 1918

Panicum flexile (Gattinger) Scribn.

Open marly bog in Bergen swamp. H. D. House, August 23, 1918

Muhlenbergia foliosa Trin.

Open places in the marly bog of Bergen swamp. H. D. House August 23, 1918.

Muhlenbergia umbrosa Scribn.

Low wet woods, Bergen swamp. H. D. House, August 23, 1918. Collections in the state herbarium indicate that this grass is not rare north of the Hudson highlands.

Sporobolus vaginiflorus (Torrey) Wood

Open marly bog of Bergen swamp. H. D. House, August 23, 1918

Lycopus asper Greene

Shady places, Bergen swamp. H. D. House, August 14, 1916.

The finding of this species, a native of the middle and western states, in Bergen swamp, is not surprising in view of numerous other western plants found in Bergen swamp and other localities in western New York.

The chief characteristics of this species are the rather stout stems perennial by stolons at the base, strongly pubescent toward the summit, puberulent or glabrate below and on the leaves. Leaf-blades oblong-lanceolate, closely sessile, sharply serrate with rather distant, ascending, low teeth; bracts acuminate-subulate, some of them often as long as the flowers; calyx somewhat two-lipped, the upper lip with three subulate-lanceolate teeth, the lower lip with two somewhat shorter and merely acute teeth; corolla white and somewhat longer than the calyx; nutlets shorter than the calyx, but as long or longer than the calyx-tube, brown and puberulent.

Nabalus trifoliatus Cass.

Chiefly in the shady portions of Bergen swamp. H. D. House, August 23, 1918. **Nabalus serpentaria** (Pursh) Hook was also observed as a frequent species here, and occasionally both were to be found on the borders of and even on the firmer portions of the marly bog in the center of the swamp.

Solidago uliginosa Nutt.

Common in Bergen swamp. H. D. House, August 28, 1918. Rather variable, one form being weak and slender, another form possessing leaves rather thin and narrow.

Other golden-rods common in Bergen swamp and observed on this date are Solidago patula, Solidago rugosa, Solidago serotina gigantea, Solidago ohioensis, and Solidago houghtonii.

Aster acuminatus Michx.

Shaded portions of Bergen swamp. H. D. House, August 23, 191
An infrequent species in western New York, although common
abundant in central and northern New York. It has not bee
reported from the Chemung valley and but three or four localities a
known for it in Monroe county and vicinity.

HERKIMER COUNTY

Dryopteris marginalis (L.) A. Gray

Dr R. C. Benedict (American Fern Jour., 6: 83. 1916) remarl
concerning the absence of this fern from the Fulton Chain region
the Adirondacks. Small but fertile specimens were collected in 19
by H. D. House and E. P. Killip on a mountain side above Inlet,
the head of Fourth lake, close to the Hamilton county line. T
species was seen nowhere else along the Fulton Chain, which
remarkable considering the abundance of this fern in other parts
the State.

Malaxis monophylla (L.) Sw.

Cedar swamp near Jordanville. H. D. House, July 12, 1918.

x Limnorchis media Rydb.

Open places in a cedar swamp near Jordanville, with Limno
chis dilitata and Limnorchis hyperborea. H. I
House, Mr and Mrs Edward A. Eames, July 12, 1918.

In most respects this corresponds to what was described by Rydbe
(Torrey Bul. 28:618; Britton's Manual, 294), and is, without mu
doubt, the same as the type of that species, as I recall it from a caref
examination made several years ago. If Doctor Rydberg had po
sessed living plants his description might have been somewhat diffe
ent. The flowers are never purplish, but usually a faint greeni
yellow, often quite yellowish, never pure white like dilatata, nor
green as hyperborea. The intermediate character is further indicat
by the shape of the lip, which is somewhat dilated at the base, but n
so much as in dilatata, and the curved spur which is but slight
inflated. Growing with both L. dilatata and L. hyperbore
the hybrid origin of the form seems almost beyond question. Doct
Peck (N. Y. State Mus. Bul. 67, p. 20. 1903) also reports it from th
locality. It is regarded by Oakes Ames as a variety of L. dilatat
(Rhodora, 10:70. 1908).

Sanguisorba canadensis L.

Island in Rondaxe lake, northern Herkimer county. Harriet B. Badean, August 18, 1918.

x Aster blakei (Porter) hyb. nom. nov.

Aster nemoralis var. Blakei Porter.

Five ponds, Herkimer county, C. H. Peck. The leaves are oblong-lanceolate, toothed, 1-2 cm wide and 5-9 cm long. Heads of flowers several on each stem. Almost intermediate in appearance between Aster nemoralis and Aster acuminatus. Doctor Peck also collected typical specimens of Aster nemoralis at Five ponds and Aster acuminatus is one of the commonest wild asters of that region. These circumstances seem to indicate that the var. Blakei should more properly be regarded as a hybrid species.

GREENE COUNTY

Boehmeria drummondiana Weddell

Van Louven lake, near Catskill. H. D. House, August 22, 1915. Also collected near Kirkville, Onondaga county, July 26, 1914.

Doellingeria infirma (Michx.) Greene

Near Cairo. H. D. House, August 20, 1915. Also collected near Troy, Rensselaer county, by E. C. Howe (herb. N. Y. State Museum).

Apparently a rare species in New York. It is reported from Chemung county (Lucy) by Clute (Fl. Upper Susquehanna, 58, 1898), and from Oswego (Kneiskern) in herb. Sartwell (Paine, Cat. Pl. Oneida county and vicinity, 93). Mrs L. L. H. Goodrich reports it from Onondaga county (Plants of Onondaga County, 185. 1912), but both of these last two reports should have further confirmation.

MADISON COUNTY

Abies balsamea L.

A few dwarfed and almost prostrate specimens were found in a swamp west of Oneida in August, 1918. This locality had once been an extensive tamarack swamp but was cleared and partially drained many years ago. The stunted specimens of balsam doubtless are all that remain of a more extensive development of the species here in former years. The altitude is only 450 feet, which is one of the lowest records for the species in this State. In the extensive swamps at an altitude of 1000 feet or more in southern Herkimer county, the balsam is quite abundant.

Fissipes acaule forma **lancifolia** n. f.

Leaves two, the blades relatively long petioled, and 5 to 7 inches long, narrowly lanceolate in outline, 1-2 inches broad. Pecksport. George S. Graves (in herb. N. Y. State Museum).

Panicum tennesseense Ashe

Sandy field near Oneida. H. D. House, July 8, 1918. In similar situations, near Albany, June 10, 1918.

Polygala viridescens L.

Edge of a meadow near Oneida, spreading and possibly introduced there since the meadow was last under cultivation. August 1918. This species has been observed at two or three places around the eastern end of Oneida lake which, with the locality near Oneida, are the only known records of it in central New York.

MONROE COUNTY

Panicum huachucae Ashe

Sandy field, Long pond. H. D. House, July 3, 1917. Also collected in dry marl in Bergen swamp, Genesee county. H. D. House, August 15, 1917.

In the Sartwell herbarium (Hamilton College) are specimens collected by Sartwell at Penn Yan, Yates county, under the names of "P. pubescens," "P. niditum var. pilosum Torr.," "P. nitidum var. silvicola," and "P. nitidum var. ?". The specimens from Irondequoit, Monroe county (J. B. Fuller, Proc. Roch. Acad. Sci., 5:32. 1910) reported as Panicum pubescens, doubtless belong here.

Panicum scribnerianum Nash

Long pond. H. D. House, July 3, 1917. Also reported from Irondequoit (M. S. Baxter) and from Mendon (E. P. Killip) Proc. Roch. Acad. Sci., 5:77. 1917.

Panicum sphaerocarpon Ell.

Perinton, M. S. Baxter, June 4, 1911. Also collected at Junius, Seneca county (H. D. House, August 10, 1917) and at Sylvan Beach (House). Doctor Peck collected this grass at Menands, Albany county, and at Riverhead, Suffolk county. In the Sartwell herbarium (Hamilton College) are specimens collected at Penn Yan, Yates county, by Sartwell under the names of "P. nitidum (dichotomum)" and "P. niditum var. crassifolium."

Muhlenbergia schreberi Gmel.

Hipps brook, Penfield. M. S. Baxter, September 1, 1918.

Sporobolus neglectus Nash

Railroad weed, Genesee Valley Park, M. S. Baxter, November 2, 1918. Appearing as if introduced and collected several years ago along a railroad in Rochester (herb. Baxter), and reported as S. vaginiflorus, which it closely resembles.

Viola triloba Schw.

Dry woods near Mendon. H. D. House, June 9, 1917.

Lycopus uniflorus Michx.

Marshy ground near Long pond. H. D. House, August 23, 1918. Not rare but apparently not previously reported from this section of the State.

Teucrium occidentale A. Gray

Very common in dry thickets along the eastern side of Long pond. H. D. House, August 22, 1918.

Stachys aspera Michx.

With the preceding and common. August 22, 1918.

Campanula uliginosa Rydb.

Low grounds bordering Buck pond. H. D. House, August 22, 1918. Closely resembling Campanula aparinoides Pursh, but less scabrous, flowers blue or pale blue, and the corolla larger and more deeply lobed.

Agalinis paupercula (A. Gray) Britton

(Gerardia paupercula *A. Gray*)

Moist depressions along road near Long pond. H. D. House, August 22, 1918.

Gerardia purpurea has been reported several times from the Lake Ontario basin, but in every case where it has been possible to examine the specimens upon which the report was based, they prove to be G. paupercula. Paine (Catalogue Plants, Oneida County and Vicinity, p. 108) reports it from shores of Lake Ontario and cites L. Holzer. A specimen collected by L. Holzer, "Bays along Lake Ontario on wet ground," in the state herbarium, and labelled "Gerardia purpurea" is determined as G. paupercula by Doctor Pennell.

Professor Dudley reports G. purpurea from Farley's Point Cayuga lake and from the Junius marshes, Seneca county (Cayuga Fl., 69, 1886). There is a duplicate specimen of the Farley's Point plant in the state herbarium which proves to be G. paupercula and the suspicion is strong that the Junius marsh plant is also paupercula, since that is the usual habit of this species.

G. paupercula is reported from Mendon marshes (Macaulay and Beckwith) and Bergen swamp (Baxter), Proc. Roch. Acad., 3: 91 1896. Mr Baxter also reports G. purpurea from Mendon Monroe county, but this is also probably but a robust specimen of paupercula, in view of the fact that all other so-called specimens of purpurea from this region have proved to be paupercula.

Galium tinctorium L.

Honeoye lake, on high hills. W. A. Matthews. July 1, 1918. Reported but without definite locality by Dr Anna H. Searing (Proc. Roch. Acad. Sci., 3: 71. 1896) as Galium trifidum var. latifolium Torr. No. 427.

Galium mollugo L.

Egypt, Monroe county. M. S. Baxter. Also found near Canandaigua by Mrs E. P. Gardner. Formerly regarded as a rather rare introduction but now established in many localities.

Aster multiflorus Ait.

Hipps brook, Penfield. M. S. Baxter, October 1918.

ONEIDA COUNTY

Sanicula marylandica L.

Dry woods near Trenton Falls. H. D. House, August 25, 1918.

Sanicula trifoliata Bicknell

Moist woods east of Oneida. H. D. House, September 1, 1918.

Phlox divaricata L.

Moist woods along Scanadoa creek east of Oneida. H. D. House May 23, 1918. Also collected in rocky woods near Green pond east of Jamesville, Onondaga county, on May 19, 1918.

Galium sylvaticum L.

Trenton Falls. Dr C. H. Peck, August 18, 1902. (Deposited in the state herbarium as "Galium mollugo L., long-leaved form.")

ONONDAGA COUNTY

Serapias helleborine L.

This orchid, which has been frequently reported from the vicinity of Syracuse, was collected in flower in Willet's glen, near Jamesville, July 11, 1918. Although suspected to be an introduced species there was nothing to indicate, as it grew here in the deep woods, that it had been introduced.

Anemone cylindrica A. Gray

In thin soil underlaid by limestone ledges, near Green pond, east of Jamesville. H. D. House, July 11, 1918. In Albany county and east of Oneida lake this anemone grows in sandy oak or pine barrens.

ONTARIO COUNTY

Anchistea virginica (L.) Presl.

(Woodwardia virginica (*L.*) *Moore*)

Shaded portions of a peat bog near West Bloomfield. H. D. House, August 21, 1918.

Ranunculus hispidus Michx.

Moist woods near Fishers. H. D. House, June 3, 1916. This appears to be the only record of this buttercup from this section of the State although some of the specimens reported under R. fasciculatis in the "Plants of Monroe County and Vicinity," may belong here.

Hypericum majus (A. Gray) Britton

Sullivans. M. S. Baxter, September 1, 1918.

Lathyrus latifolius L.

Escaped from cultivation and established along a roadside near Canandaigua. Mrs E. P. Gardner, July 26, 1918.

Foeniculum vulgare Gaertn.

Fields near Canandaigua. Mrs E. P. Gardner, June 28, 1918.

Apocynum medium Greene

Edge of woods, near West Bloomfield. H. D. House, August 21, 1918.

Pentstemon digitalis Nutt.

Woods near Canandaigua. Mrs E. P. Gardner, June 28, 1918.

OSWEGO COUNTY

Rosa gallica L.

Established along roadsides near Oswego. C. S. Sheldon, June 23 1881. Professor Sheldon also collected Rosa pimpinellifolia L. near Oswego, where it is established in one or two localities

Ilex verticillata (L.) A. Gray

Lily marsh, South New Haven. C. S. Sheldon, June 22, 1880 Mud lake, near North Hannibal. H. D. House, June 27, 1914 The last a form approaching var. cyclophylla Robinson.

This species, which is given a southern range in the second edition of Britton and Brown's Illustrated Flora (1913), has also been collected at Brant lake, Warren county (Peck), Van Louven lake Greene county (House), and Sylvan Beach, Oneida county, the var. padifolia (House). What appears to be the typical form of var. cyclophylla Robinson, has been collected at Round lake, Saratoga county (Peck), and at Forestport, Oneida county (Haberer).

Ilex bronxensis Britton (L. verticillata var tenuifolia Torrey), is frequent in northern swamps. Bonaparte swamp, Lewis county (Peck), and Lake Pleasant, Hamilton county (Peck).

Scirpus subterminalis Torrey

Mud lake near Hannibal. Florence Beckwith, July 21, 1918 A frequent species in the pine-barren streams of Long Island (Taylor) and in the lakes, ponds and slow streams of the Adirondack region (Paine, Peck, Haberer etc.). Outside of these two sections of the State it is a very rare species.

WAYNE COUNTY

Cassia marilandica L.

Near Savannah. Mr and Mrs Edward A. Eames, August 14, 1918 The wild senna has been reported from Wayne county by Hankenson and from Rochester by Streeter (Proc. Roch. Acad., 3:59. 1896) These constitute the only records for this region of the State Farther east it occurs rarely in Madison county and more frequently in Herkimer county along the West Canada creek and down the Mohawk to the Hudson along which river, south of Albany, it is frequently seen. It has also been reported from several localities in the Upper Susquehanna valley.

PLANTS OF THE SUSQUEHANNA VALLEY AND ADJACENT HILLS OF TIOGA COUNTY

BY FRANK E. FENNO

Second Supplementary List

The first supplementary list of plants for this region appears in the New York State Museum Bulletin 75 (1904), following the "Plants of the Susquehanna Valley and Adjacent Hills" which appeared in Bulletin 67 (1903). The additions contained in the present list are in large part from Wilkinson's swamp, which is situated on the border between New York and Pennsylvania and in the Susquehanna valley. It possesses a plant life peculiarly its own for this region. The following species, which are not found elsewhere within the limits of this flora, occur here: Cassia marylandica, Juncus balticus, Lobelia kalmii, Lathyrus myrtifolius, Lathyrus palustris, Parnassia caroliniana, Solidago uliginosa, Selaginella apus, Scirpus lineatus, Rhyncospora capillacea and Juncus brachycephalus.

Microstylis monophyllos (L.) Lindl.

Swamp at state line.

Agastache nepetoides (L.) Kuntze

Roadside near Nichols.

Arisaema stewardsonii Britton

Green's swamp north of Smithboro.

Bartonia virginica (L.) B. S. P.

Green's swamp.

Botrychium ramosum (Roth) Aschers.

Woods in the vicinity of Nichols.

Blephilia hirsuta (Pursh) Benth.

Riverbank at Nichols.

Carex flava L.

Swamps around Nichols.

Carex lurida var. **exundans** Bailey

North of Tioga Center.

Carex squarrosa L.

Swamp at Nichols.

Cassia marylandica L.

Wilkinson's swamp at the state line.

Corallorrhiza trifida Chatelain

Green's swamp.

Centaurea nigra L.

Along the river in thickets.

Dryopteris spinulosa dilatata (Hoffm.) Underw.

Frequent in woods.

Eupatorium maculatum L.

North of Barton.

Eriophorum callithrix Cham.

Tribe's swamp north of Barton.

Eleusine indica Gaertn.

Roadsides east of Nichols.

Amphicarpa pitcheri T. & G.

Wooded roadsides in the vicinity of Nichols.

Hieracium pratense Tausch.

Everywhere abundant. Twelve years ago scarcely a specimen could be found, but now it covers hundreds of acres of land in the counties of both southern New York and northern Pennsylvania.

Monotropa hypopitys L.

Near Nichols.

Habenaria fimbriata (Ait.) R. Br.
Green's swamp.

Juncus balticus Willd.
Wilkinson's swamp.

Juncus marginatus Rosth.
Moist places. Frequent.

Juncus brachycephalus (Engelm.) Buch.
Wilkinson's swamp.

Lobelia kalmii L.
Wilkinson's swamp.

Lythrum alatum L.
Near Nichols.

Lysimachia vulgaris L.
Near Nichols.

Lathyrus myrtifolius (Muhl.) Gray
Wilkinson's swamp.

Lathyrus palustris L.
Wilkinson's swamp.

Muhlenbergia foliosa Trin.
On rocks west of Barton. A well-marked variety.

Ophioglossum vulgatum L.
Near Waverly.

Parnassia caroliniana Michx.
Wilkinson's swamp.

Polygonum hartwrightii Gray
Swamps. Common.

Polygonum lapathifolium L.
Swamps. Frequent.

Rosa setigera Michx.

The Narrows at Tioga Center.

Salsola tragus L.

Along the railroad tracks at Nichols.

Selaginella apus (L.) Spring.

Wilkinson's swamp.

Scirpus lineatus Michx.

Wilkinson's swamp.

Sparganium androcladum Engelm.

Swamps. Frequent.

Scirpus pedicellatus Fernald

Not uncommon in swamps and wet places.

Scirpus atrocinctus Fernald

Wet places, frequent.

Scirpus atrocinctus var. **brachypodus** Fernald

With the species.

Scirpus rubrotinctus Fernald

Along the river at Nichols.

Rhynchospora capillacea Torr.

Wilkinson's swamp.

Thalictrum revolutum DC.

Rocky woods at Nichols.

Woodsia obtusa (Spreng.) Torr.

On rocks west of Barton.

NOTES ON THE HABITS AND DEVELOPMENT OF THE FOUR-TOED SALAMANDER, HEMIDACTYLIUM SCUTATUM (SCHLEGEL)

BY SHERMAN C. BISHOP

The four-toed salamander, Hemidactylium scutatum (Schlegel), although widely distributed has been considered uncommon in almost every locality from which it has been recorded. So little has been written concerning the habits of this species that an account of the finding of the animal and its eggs in abundance and a description of some of the stages of its development may prove of interest and throw some light on questions involving metamorphosis and habits not heretofore answered.

The genus Hemidactylium, represented by the single known species, is closely related to Plethodon from which it differs structurally in the absence of the fifth toe on the hind foot and, in a slight degree, in the number and arrangement of the teeth. If the deficiency in digits be disregarded, there is no more diversity in the characters of Hemidactylium and Plethodon than is found in members of the genus Plethodon itself. From the genus Batrachoseps, after which it is usually placed, it differs, according to Cope ('89), in having a prefrontal bone. In common with other members of the family Plethodontidae, the four-toed salamander is lungless. Of the several species of Plethodon, it is most nearly related to P. cinereus, both in structure and habits. Like that species, it has the tongue attached medially in front with the side margins free; but the median line of attachment in H. scutatum is confined to the anterior half, while in P. cinereus it is continued almost to the posterior margin.

Parasphenoid teeth in H. scutatum in two elongate areas well separated; in P. cinereus these areas are almost contiguous; vomero-palatine teeth in two crescent shaped patches and more numerous than in P. cinereus. Externally H. scutatum differs markedly from P. cinereus in the color of the head, trunk and under parts, in its less robust form, and by having but four toes on the feet.

In its adaptation to terrestrial life the four-toed salamander again approaches the red-back (P. cinereus), although in this respect it has not gone as far.

The following description of the female is from a living, mature specimen found coiled about her eggs May 30, 1919. Total length, 75 mm; tail, 42.4 mm; head, length, 8 mm, width, 5.6 mm (behind eyes). Color: head and trunk above dark reddish brown, becoming grayish on the lower part of the sides between the costal grooves; snout, lighter, bronzy; upper side of limbs and tail with a ground color of reddish orange blotched with darker brown; a small, elongate, light reddish patch on shoulders above the arms and less distinct specks of the same color in the costal grooves on the back. Below, bluish white with irregular flecks of black mostly distributed along the sides; center line of tail free from spots, that of belly nearly so.

The head is broad and flat, with the sides nearly parallel; the snout b'unt; the eyes are prominent and more or less retractile; trunk cylindrical and short; tail long, the posterior half keeled indistinctly above and below. Constriction at base of tail prominent, a short distance behind anus. The limbs are slender but strong; fingers and toes four, the inner and outer rudimentary.

A distinct median dorsal groove originates near the base of the tail and extends onto the head where it bifurcates and sends a branch to each eye (plate 3, figure 2); thirteen or fourteen costal grooves, the upper extension of which meet the dorsal groove at an acute ang'e; gular fold prominent, continuing onto the neck where it meets a lateral groove extending to the eye. The entire surface of the skin has a finely pitted or granular appearance.

Moesel ('18) states that the male is usually darker on the dorsal surface of the body than the female, and that the ventral surface is somewhat differently marked, that is " . . . is milky-white with large inky-colored spots along the edges of the belly, throat and pectoral regions. The abdominal region is devoid of spots." C. and H. Thompson record specimens of both sexes taken from beneath a log in April in which the females were, ". . . fully twice as large as the males." I have no specimens of males and am unable to add to the above accounts.

A half-grown specimen 30.4 mm long, anomalously colored, has a striking resemblance to some specimens of Plethodon cinereus. The red of the back of the tail in young four-toed salamanders is often continued well forward over the trunk but in this specimen the ventral surface is also aberrantly marked. Instead

of irregular black spots distributed mostly along the sides of the belly and tail, this specimen has dull-brown spots (on a bluish ground) more or less uniformly spread all over the venter (plate 5, figures 1 and 2).

Distribution

The range of Hemidactylium as given by Stejneger and Barbour ('17) is as follows: "Massachusetts, southern Canada westward to Michigan, south to Georgia and the Gulf States, also Arkansas and Illinois." West of the Mississippi it has been recorded from Hot Springs, Arkansas and Bourbon, Crawford county, Missouri (Hu ter and Strecker, '09). It will undoubtedly be found in all New England states if search be made at the proper season of the year in the somewhat restricted habitat in which it occurs during the period of egg deposition and development.

The species was added to the fauna of New York State by S. F. Baird, who presented living specimens to the State Cabinet of Natura History in 1851. These specimens with several of other species, "were all caught in the course of an hour, on the farm of Joseph C. Tiffany, Esq., near Coxsackie." (Baird '52). This early record was evidently overlooked by Paulmier ('02), in the "Lizards, Tortoises and Batrachians of New York," as the following statement under the account of the species indicates: "Probably to be found in this State."

In the Cayuga lake basin where the species has probably been more frequently taken than elsewhere in the State, it has been considered uncommon. Some early records given in "The Vertebrates of the Cayuga Lake Basin, N. Y.," by H. D. Reed and Albert H. Wright ('09) are here quoted: "The first specimens were obtained near Ithaca in the valley of Sixmile creek by H. W. Norris in April, 1889. No other specimens were found in this basin until October 22, 1905, when twenty-one specimens were found on Larch hill, two mi es south of Ithaca on the east side of the inlet valley. They were all found under stones or about the bases of stumps in the open."

For the following records from the vicinity of Ithaca, N. Y., I am indebted to Miss Julia Moesel of Elmira College who kindly permitted use of that part of her master's thesis (Cornell '18) pertaining to the four-toed salamander: "April 6, 1914, three females were taken in Enfield gorge. A single specimen was taken in the evergreen woods at Ellis Hollow on May 16, 1916." "On April 16, 1914 . . . upon the hillside overlooking the inlet of

Cayuga lake and about 40 feet over the roadway . . . two families of four-toed salamanders were taken. One family consisted of a single adult, a female, and three young, while the second included a male, a female and three young, each about 1.8 cm long."

"On October 9, 1916, three individuals were discovered at the base of the same hillside, almost at a level with the roadway. Here they were concealed beneath the stones, one specimen hiding upon the earth surface, the other two having been unearthed from burrows about 6 or 7 inches below the surface. About three weeks later, on October 29th, five varying-sized individuals were taken from beneath stones lying in a direct line about half way up the hillside."

On October 28, 1917, Henry Dietrich took two adult specimens from beneath stones on Larch hill. R. F. Deckert ('14) records Hemidactylium from Silver Lake Park where he says that it has been repeatedly taken, usually in or under logs.

Ditmars ('05) states that the species in the vicinity of New York City is mostly distributed along the Palisades of the Hudson river. Mearns ('98) records a single specimen from the Hudson highlands taken in October, 1896. In the collections of the State Museum is a specimen from Orient Point, Long Island, received May 6, 1911; three specimens from Altamont, N. Y., taken October 12, 1906, and a single individual from Elizabeth island, Lake George, taken by the writer from beneath a log August 2, 1917.

Habitat

Published accounts usually record this species from terrestrial situations. According to Ditmars (ibid.), "It is strictly terrestrial and inhabits timbered regions, where it hides under logs and stones." By Sherwood ('95), it was found in the open woods where grass was growing; "All were under stones and curled. Single specimens taken at Harrington, N. J., from under boards of logs about 5 feet from a pond. Time of captures May and June." W. H. Smith ('82) " . . . Found in April under old logs and rails in open woods at some distance from the water." C. and H. Thompson, ('12) state that specimens were "found (May 13, 1901) in earth on the roots of a violet which had been pulled up"; "under loose moss"; "April, 1902, under a log"; "one was just inside the bark of a rotten stump." On Larch hill, near Ithaca, specimens were found under stones and the bases of stumps. Reed and Wright (ibid).

Specimens recorded by Moesel from hillsides near Ithaca, "were taken from beneath large, flat stones which were well imbedded and surrounded by a mass of shrubbery." Others, as before noted, were found buried to a depth of 6 or 7 inches.

A few specimens have been taken in situations less terrestrial. In his account of the Batrachia and Reptilia of Onondaga county, Britcher ('03) includes a single specimen taken in sphagnum moss in a swamp on the Jamesville road. I am indebted to Mrs A. A. Wright of Ithaca for a similar record. On June 11, 1916, while searching for a small orchid, Listera australis, Mrs Wright found a specimen in the sphagnum of the Duck Lake bogs, about 7 miles north of Savannah, N. Y.

The base of Larch hill, above mentioned, is bordered on the west by a broad meadow formerly with large areas of sphagnum but now being fast converted by ditching operations into land suitable for cultivation. On June 16, 1919, Dr A. H. Wright and the writer visited this locality but a thorough search failed to reveal a single specimen of the four-toed salamander. Although few specimens had been actually recorded from sphagnum bogs, the intimate association of the species with this type of environment was pointed out by Wright ('18) who stated, "The four-toed salamander (Hemidactylium scutatum) . . . is vanishing with the drying up or draining of sphagnum bogs and feather bed swamps." It is certain that the final conversion of sphagnum areas will mark the extirpation of the species in such localities, unless in their progressive adaptation to terrestrial life, they select more varied situations for deposit of eggs.

General Habits

The habit of coiling up when disturbed or exposed was observed by Sherwood (ibid) and independently by A. H. Wright, who expressed the opinion that the habit was perhaps correlated in some way with the attendance of the female upon the eggs; a conjecture verified to some extent by subsequent observations. Two habits of Plethodon cinereus, leaping and autotomy of the tail, described by Piersol ('09) as of rare occurrence among Urodeles, have both been observed in Hemidactylium. The leaping process in the latter, however, seems to be accomplished more by violent contortions of the body and tail than by use of the limbs.

Although several individuals were taken in the field with tails in various stages of regeneration, the inclination to part with this

member was not particularly evidenced in specimens handled in captivity. One very active salamander, however, too roughly treated, left its tail wriggling on my desk and started to crawl away. With preserved specimens, the greatest care in handling is required to keep body and tail together.

The definite constriction at the base of the tail in Hemidactylium marks the line of separation of the skin in autotomy (plate 3, figures 1–2–3). A short distance in front of this constriction there is a less prominent depressed line which indicates the point of detachment of muscles and vertebrae. By this provision the skin, on separation, is of sufficient length to cover the wound of the stub over which it immediately shrinks. The detached portion of the tail wriggles violently for a few minutes and if stimulated by pinching or with acetic acid the contortions continue for a longer time.

A specimen in captivity was induced to cast off the tail by touching the back with a drop of dilute acetic acid. A single violent wrench of the body sufficed to separate it from the tail. Plethodon eschscholtzii (oregonensis) is said to have a constriction similar to that of Hemidactylium and in addition well-developed dorsal glands of the tail. In P. cinereus there is no such specialized device or great development of dorsal glands, autotomy occurring at almost any point back of the anus. The provisions for protection of the wound noted in Hemidactylium are practically those observed by Piersol (ibid) in Plethodon.

Well hidden beneath stones or bark or buried deep in sphagnum moss for the greater part of the year and doubtless further protected by disagreeable secretions of the skin, this salamander probably has comparatively few enemies. The greatest danger must occur during migration or at night if it be given to nocturnal ramblings.

The food of Hemidactylium probably consists principally of insects. C. and H. Thompson (ibid), observed it to take small flies in captivity. O. P. Hay ('92) states, "The food is said to consist principally of worms and insects." The stomach of a female taken at Ringwood (near Etna), N. Y., May 20th, contained the larva of one of the Micro-lepidoptera (Crambinae and probably of the genus Crambus) and the remains of some small Staphylinids. Sphagnum moss and bog litter in general contain a varied and extensive fauna of the smaller invertebrates which undoubtedly contribute to the support of Hemidactylium and other bog-dwelling forms. Spiders, mites, beetles and Thysanura are particularly

numerous. Larvae of various species of Lepidoptera and pseudoscorpions occur; even amphipods are sometimes found.

I have not observed internal parasites in the adult salamanders but the gelatinous envelops of several of the eggs were infested with small nematodes that moved about in the semifluid mass.

That there is an increasing adaptation to terrestrial life and increasing degree of parental care of eggs and larvae in the series represented by Ambystoma, Desmognathus, Plethodon and Oneides (Autodax) has been pointed out by Piersol. In this series may be placed Hemidactylium which in adult life is as terrestrial as Plethodon and more so than Desmognathus. The egg complement (40–60) of Hemidactylium, however, is larger than that of Desmognathus (15–20, Hilton, '09) or of Plethodon (3–12, Piersol, '09) and the eggs are laid in situations which are in closer relation to water than those of either of the other species. The larger number of eggs and the fact that they are deposited in situations that give them abundant and constant supply of moisture, may be an indication of more recent adaptation to terrestrial life; if so, Hemidactylium has gone farther and faster than Desmognathus fusca, both in the larval and adult condition.

Breeding Habits

Very little has been published concerning the breeding habits of Hemidactylium. O. P. Hay (ibid) stated that the eggs were found in moss at the roots of trees that stood near ponds, and that they were said to resemble the eggs of P cinereus. Cope is reported as saying that the gills are absorbed at an early period in life and that the animal never enters the water. Ditmars (ibid) expressed the opinion that the young possessed branching gills when hatched but lost them in a few days. As no specimens were mentioned, the statements of Cope and Ditmars may have been conjectures based on general knowledge of related forms. In their account of the species, C. and H Thompson remarked, "The eggs are laid under moss or bark, and the salamander at least in the adult condition avoids water."

Moesel ('18) examined the ovarian eggs of specimens taken April 11, 1917, on Larch hill and June 11, 1916, at Duck lake and found them to be of large size, 2 mm in diameter. She states further that they were pigmented, a little less than half of the egg being "of a dark grayish brown shade." Fifty-three eggs were found in the first specimen examined and fifty-seven in the other. The conclusion was reached that the period of ovulation occurred during

late April or early May in the vicinity of Ithaca and somewhat later in the vicinity of Duck lake. The ovarian eggs observed by Moesel correspond closely in number to those actually found in the field where complements were noted containing, on the average, about fifty. These notes constitute practically all that has been recorded concerning breeding habits of the species.

On May 14, 1919, the writer, while sifting for spiders with Prof. C. R. Crosby of Cornell University, found the eggs of the four-toed salamander with the female coiled about them in the bogs of the Mud pond basin near McLean, N. Y.

The McLean bogs are part of a series extending in a northeast-southwest direction between Ithaca and Cortland, N. Y. Originally of considerable area, the actual sphagnum-heath formations are now of comparatively small extent and diminishing with the encroachment of grass and shrub and tree. Mud pond itself (plate I, figures 1 and 2) is surrounded by bushy swamps and grass bogs with occasional patches of sphagnum and other mosses scattered about the margin among the clumps of shrubs. A characteristic shrub, herb and sphagnum association on the border of this pond may be presented as a typical habitat of Hemidactylium during the period of deposition and incubation of the eggs.

The common woody shrubs are represented by clumps of red-osier dogwood (Cornus stolonifera), hoary alder (Alnus incana), and an occasional shad bush (Amelanchier sp). A few seedlings of the arrow-wood (Viburnum dentatum) and vines of Clematis virginiana find root among the larger shrubs. The herbaceous plants consist principally of small groups of meadow rue (Thalictrum polygamum), white violet (Viola blanda), touch-me-not (Impatiens biflora), water pennywort (Hydrocotyle americana) and scattered single plants of the cuckoo flower (Cardamine pratensis). In the open water spaces between, the marsh marigold (Caltha palustris) and other bog-loving forms are scattered. Rank growths of sphagnum and other mosses cover the roots and bases of the shrubs and in these masses of moss the four-toed salamander lays her eggs (plate 2, figures 1 and 2).

In every instance the eggs were found buried to a depth of 3 or 4 inches in the moss and within 6 inches of the water. In every instance the female was found either partly coiled upon the eggs or about them. When disturbed the female often made an effort to escape by burrowing in the moss but sometimes she seemed inclined to stay with her eggs. It is almost impossible to find

the eggs of Hemidactylium without disturbing their position somewhat in removing the covering of moss, but in general it may be stated that they are disposed in a mass and are stuck firmly together and to rootlets, and stems of moss (plate 4, figures 1–3).

The first lot of eggs found (May 14th) contained ninety, but were probably the complements of two females as a second was seen but not captured. Subsequent observations on the number of eggs deposited strengthen this conjecture. On May 27th A. H. Wright and the writer again visited the bogs, and other specimens were found in like situations within a few feet of the former. At this time, a female and her eggs, about fifty, and a female without eggs were taken. A third specimen was left as found partly coiled about her eggs. On June 30th A. H. Wright found that this female and her brood had departed. On May 27th Henry Dietrich of Cornell University, while collecting at the Ringwood bogs near Etna, N. Y., found one adult and two half-grown four-toed salamanders in the moss near water. One week before two adults were taken by him in the same place.

As the first female taken, confined too closely, failed to survive transportation from McLean to Ithaca, the unattached female taken May 27th was placed with the original lot of eggs which she soon appropriated and coiled about.

Other parts of the margin of Mud pond were explored May 30th and nine more egg masses found, in each case as before, within 6 inches of the water and attended by the female. In one side of a small clump of sphagnum were four females and a total of 204 eggs; the egg masses were not distinctly separated, in fact so close that it was impossible to confine each female to her own. Other specimens were noted with eggs in clusters of 22 to 64.

Whether fertilization of the eggs takes place in the fall or spring is not known. The spermathecae of Hemidactylium were not examined by Kingsbury ('96) when he made his comparative study of these organs in several species of salamanders. In seeking an answer to this question several dissections were made and the following conditions noted: In all females examined ovarian eggs were found in various stages of development. A single ovary from each of several specimens, taken May 30th and killed June 10th, contained from 90 to 100 eggs varying in size from almost microscopic to .5 mm in diameter. The larger eggs were unpigmented, white and opaque; the smaller, clear with an opaque center and confined to the center of the mass. The condition of some of these eggs might be considered evidence that mating takes place in the spring;

and the fact that males and females have been taken from beneath the same log (C. & H. Thompson '12, p. 36) or stone (Moesel '18) at this time of the year points to the same conclusion.

The four-toed salamander has been taken in the spring as early as April 7th (Wright and Allen '13) and this date probably approximately marks the beginning of general release from hibernation (in the latitude of central New York) and the preparation for mating and migration of the females at least, to situations favorable to development of the eggs. All adult specimens taken in the bogs were females, the sex being determined by dissection. As half-grown specimens have also been found in bogs, it is probable that they too perform the seasonal migration.

Developing eggs were kept in sphagnum moss in jars and cans, some of which in turn were surrounded by moss. With three groups of the eggs a female was placed, the others were simply covered by moss. Apparently the attendance of the female made no difference with the development of the eggs as long as the moisture content of the moss approximated conditions in the field. Eggs kept in moss saturated with water became mouldy and many were lost.

Drawings of the earlier development stages were made from specimens placed in 60 to 70 per cent alcohol on successive days; later stages from live embryos selected at longer intervals. Only those stages showing some particular feature of development are considered in this account, although a constant check was kept on all stages. In all stages the envelops of the eggs are represented more or less diagrammatically as the thickness of these envelops varied constantly with their water content.

Eggs

Unlike the eggs of Desmognathus fuscus, Plethodon cinereus and some others, those of Hemidactylium are not stalked but cling together and to the surrounding moss by the adhesiveness of their gelatinous coverings (plate 4, figures 1 and 2).

In size they vary from 2.5 to 3 mm in diameter and are inclosed by two, at least, gelatinous envelops which give them a total diameter of 4.5 5 mm depending to a considerable extent on the amount of moisture present and consequent absorption. The outer of the two distinct envelops is comparatively thin, tough and elastic; the inner, more fluid in its consistency like clear jelly. In some stages of development it was possible to distinguish a thin vitelline mem-

brane closely surrounding the embryo and separating it from the more fluid envelop.

The eggs were very slightly pigmented on one side when found but it is highly probable that when deposited they were less so. The unpigmented parts were given a light tinge of color by the yolk. Deposited as they were in damp moss, it was often necessary to wash the eggs or remove the outer envelop entirely to free them from adhering bits of rubbish.

Development of the Embryo

When found (May 14th) the eggs were well advanced in development, the earliest stage noticed having the medullary folds fully formed though not yet approximated. As early segmentation and gastrulation stages are normally passed through rapidly, the eggs probably had not been deposited longer than 48 to 72 hours before being discovered (plate 6, figure 1). There is no trace of the blastopore although such early disappearance may be considered unusual. Of the series of eggs examined, only one revealed the conditions noted above, the remaining specimens being considerably more advanced. Another specimen taken the same date has the embryo well defined (plate 6, figure 2), with a median longitudinal depressed line marking the union of the medullary folds. Body divisions are not apparent in this stage unless the slight widening of the anterior end of the embryo be considered as defining the limits of the head. About two-thirds of the circumference of the egg is occupied by the encircled embryo in this stage.

May 16th. Definite head and body regions are evident. Back of the head a slight swelling indicates the position of developing tissue for gill and arm buds. In front, the head is slightly free. The egg is considerably elongated but whether from distortion or influence of the embryo is not apparent (plate 6, figure 3).

May 19th. The development of tissue, which barely indicated the position of gill and arm buds in the preceding stage, shows marked increase and with the head comprises fully one-half the mass of the egg. The embryo is folded upon itself, the head, gill and arm regions occupying one hemisphere, the yoke mass the other. A slight narrowing of the head in front and more definite pigmentation give indications of forming eyes and snout (plate 6, figure 4).

May 21st. The eye regions are highly pigmented and the tissues of the developing gill and arm buds greatly increased in thickness. The three primary divisions of the body, head, trunk and tail are now recognizable; the tip of the tail is in contact with the under

side of the snout (plate 6, figure 5). In this stage a delicate membrane, surrounding the embryo, separates it from the jellylike envelop.

May 25th. The embryo shows but little advancement in this period although it is possible that the specimen selected does not represent the normal development. A slightly more pronounced constriction back of the gill and arm region, an increase in the length of the tail and some reduction of the yolk mass is evident (plate 6, figure 6).

May 27th. Buds of the gills and arms defined by lateral depressions; trunk and tail assuming definite shape and yolk mass confined to the region of the lower abdomen. Pigmentation increasing in the eye areas and along the sides of the back and tail.

Drawings of the foregoing stages are from preserved specimens; those which follow were made from living embryos.

June 2d. Length of embryo, 7.3 mm (plate 7, figure 2).

The embryos in this stage are active and revolve freely on their long axes within the gelatinous envelops. The pupils of the eyes are developed; the gill and arm buds are of considerable size. In the specimen figured there are three gill buds on the right side, each separate, on the left but two and these coalesced. The gill slits are still imperforate. Pigment distributed in small flecks on the dorsum.

June 4th. Length 9.4 mm (plate 7, figure 3).

There is a marked development of the gills, the longest equal in length to the head. The fringed condition of the fully developed gills is here presaged by shallow scallopings of the margins. The gill slits now perforate; circulation evident in the gills and along the venter. Pigment spots coalescing more or less giving a decided color pattern to the back and sides. Body behind the head compressed; the posterior two-thirds of the trunk and tail distinctly keeled above, the tail also keeled below. Arms half as long as the head, legs indicated by slight swellings at the base of the tail.

June 6th. Length 12.6 mm (plate 7, figure 4).

Gills fully developed, the fingers of the hand partly so. Legs represented by mere swellings in the preceding stage, now half as long as the arms and notched at their extremities. Of the total length of the body, the tail occupies two-fifths. Trunk above keeled almost to the head; the tail keeled above and to the origin of the legs below. General color and pattern pickerel-like. The flecks of yellowish green and orange pigment originating among those of light and dark grey, by spreading and uniting give a mottled appearance to the sides. On each side of the middle line of the back and tail

alternating spots of light and dark gray; the light spot of one side opposite the dark of the other.

June 12th. Length, 13.8 mm (plate 7, figure 5).

Larvae free from gelatinous envelops of eggs. No marked changes except in development of fingers and a slight increase in size. Color pattern slightly modified by coalescence of spots on the back of trunk and tail. The figure is of interest particularly because it shows the extremely compressed, wedge-shaped body.

June 19th. Length 15 mm (plate 7, figure 6).

Gills about half their original length; arms and hands fully developed, the second and third fingers proportionally longer than in the adult. Legs with middle joint free, feet with three toes. Body and tail robust and taking on adult proportions. Center line of back with a series of light gray spots diminishing from before backward and bordered by darker gray, the result of fusion of the alternating spots developed in a previous stage.

June 20th. The single specimen showing reduction of gills, found dead on this date. Attempts to secure additional specimens to complete the series of development stages and show final reduction of the gills were unsuccessful. The sphagnum of the bogs bordering Featherstone lake (near Mariahville, N. Y.) was examined and search made in the thick moss growing about the bases of stumps on the edge of a small hill-top pond, near Ballston lake, New York, but without results.

The amount of yolk in the eggs of Hemidactylium is proportionally smaller than that found in P. cinereus or D. fuscus. In other words, the developing embryos of Hemidactylium have greater bulk compared to the mass of the yolk than is the case in the other species mentioned. In that stage of development of D. fuscus in which arm and gill buds are evident from surface views, the embryo is of relatively small size and encircles the egg (Hilton '09, plate 4, figures 47–48). Practically the same is true of P. cinereus. In Hemidactylium, however, by the time the gill and arm buds are well formed, the yolk mass is confined to the abdominal region of the embryo and greatly diminished; even at an earlier stage considerable reduction of yolk is evident (plate 6, figures 5–6; plate 7, figure 1). The condition of Hemidactylium is perhaps nearer that found in Eurycea (Spelerpes) bislineata whose eggs are deposited in water (Wilder '99).

Early absorption of the yolk presupposes ability in the young larvae to take food independently soon after leaving the egg; but specimens observed, although capable of considerable movement,

appeared entirely unfitted to capture insects or take solid food. The undeveloped condition of the limbs at the time of hatching gives evidence of the helpless condition of the larvae, particularly when they are not in an aquatic environment. Inez W. Wilder ('13) found newly hatched larvae of D. fuscus very active and able to crawl about; certainly the young of Hemidactylium are incapable of doing this when reared under laboratory conditions. The aquatic larval period of D. fuscus perhaps necessitated the early full development of limbs to enable them to reach the water. Conversely, the absence of an aquatic condition in Hemidactylium may account for the lack of such development although the necessity of being able to capture food remains.

Pigmentation of the integument, as observed in the development of Hemidactylium, has three distinct phases. The earliest indication of color appears as thin wash of pigment more or less regularly distributed. In the second stage the pigment is in irregular flecks confined mostly to the dorsal surface of the body. By spreading and uniting the color pattern is developed in the third stage.

The length of time the gills are retained in larvae reared under artificial conditions depends, to a considerable extent, upon the moisture content of the moss in which they are kept. To determine if possible the influence on development of such factors as light and moisture, some experiments were conducted along the following lines: In some specimens taken May 30th the embryos were supplied with fully developed fringed gills, but still inclosed, June 12th, within the gelatinous envelops. Of these eggs, two lots of about a dozen each were placed in glass jars containing sphagnum moss, supported by a wire screen placed an inch above the bottom of the jar. Water in the jar insured a constant humid condition without being in contact with the moss.

On June 19th larvae were found free in the moss and adhering to the sides of the jars. On June 21st, four specimens in jar 1 and three in jar 2 were found in the water in the bottom of the jars having worked their way through two and one-half inches of moss. Of these seven specimens, but one was alive. On June 23d the remaining specimens died without showing the slightest reduction of gills.

The fact that some larvae worked their way through the moss and into the water probably has no significance. Several artificial conditions imposed on the specimens used in the experiments have no counterpart in nature. (1) To reach the water level in bogs,

the larvae would have to burrow through 5 or 6 inches of moss. (2) The burrowing of the specimens kept in glass jars may have been induced through efforts to escape too much light. (3) The moss in the jars was loosely placed and permitted easy access to the water. Finally, the fact that all but one of the specimens were dead when found is in itself evidence that the occurrence was accidental.

The original lot of eggs from which development stages were taken was placed in a glass jar with a perforated top, the whole being kept most of the time surrounded by moss, in a large can. The moss in this jar was damp but not saturated. On June 6th gills were fully developed. Removal of dead individuals and those representing stages of development reduced the original number to three specimens, which on June 12th escaped from the egg envelops. To hasten reduction of gills one of these was placed in moss only sufficiently damp to prevent drying of the specimen. One week later, June 19th, the gills on this specimen were shortened to half their original length.

To recapitulate: Larvae taken May 30th, with gills fully developed and kept in moss saturated with water, left the eggs June 19th and retained the gills without apparent reduction until June 23d, when they died. The young then were retained 20 days in the egg with gills fully developed. Larvae of the original lot of eggs arrived at the gill stage June 6th, escaped from the eggs June 12th and, in the one specimen that survived, considerable reduction was evident June 19th. Specimens with gills in this case, remained within the egg only 6 days.

Thirty days were required to complete the development of larvae in the eggs if, as estimated, they had been deposited 3 days before being discovered. In one specimen the gills were reduced to half their original size in 7 days more. If this be considered a normal reduction, then complete loss of the gills might be accomplished in an additional week or two and the total length of time required for development and transformation be limited to a period of about 5 weeks. The fact that the female found with eggs May 27th had disappeared with her brood some time before June 30th affords some evidence that the whole period of transformation may be accomplished within the limits estimated. The length of time, however, probably varies considerably, as indicated by the retention of gills in larvae kept in saturated moss.

The period of egg-transformation of common species in the east is considerably longer than that estimated for Hemidactylium, as

may be seen from the following data taken from the Field Note Book of Fishes, Amphibians, Reptiles and Mammals by A. H. Wright and A. A. Allen:

Spotted salamander, Ambystoma maculatum (Shaw) Egg-transformation 4–6 months
Red-backed salamander, Plethodon cinercus (Green) 2.5–3 months
Purple salamander, Grinophilus porphyriticus (Green) Possibly 2 or more years
Two-lined salamander, Eurycea bislineata (Green) Possibly 2 years
Newt, Notophthalmus viridescens (Raf) 4–8 months

In the case of D. fuscus, Wilder estimated the probable duration of incubation alone to be 5 weeks, and the aquatic larval period, during which the gills are retained, to extend over an additional period of 9 to 10 months.

The chief points of interest in the life history of the four-toed salamander may perhaps be profitably summarized: Adults of both sexes are strictly terrestrial during the greater part of the year. In the latitude of central New York release from hibernation occurs in April and it is probable that pairing of the sexes takes place soon after. During the latter part of April or early May the female, at least, migrates to situations suitable for ovulation and after depositing the eggs remains with them. The period of incubation is variable depending on conditions but doubtless limited to 30 or 40 days. From the scant evidence of observations on a single individual it may be that transformation is accomplished in an additional period of 10 to 20 days. The adult size is probably not reached until the end of the year following that of transformation. Migration to terrestrial situations from the bogs must occur in summer or early fall.

The large number of eggs deposited, their intimate relation to sources of moisture and early absorption of the yolk, indicate recent adaptation to terrestrial life.

Acknowledgments

I am particularly indebted to Dr A. H. Wright of the department of zoology, Cornell University, for kindly interest and suggestions, many notes and personal observations on the four-toed salamander and for identification of plants in the field; to Prof. C. R. Crosby of Cornell for photographs here reproduced, all of which were taken under adverse conditions; and to Miss Julia Moesel, who kindly loaned me her account of the species, containing many records and observations.

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EXPLANATION OF PLATES

Plate I

Fig. 1 General view of Mud pond and surroundings from the south.

Fig. 2 Southwest side of Mud pond with its bordering growths of shrubs, herbs and sphagnum; the typical habitat of Hemidactylium during deposition and incubation of the eggs.

Plate 1

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Plate 2

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Fig. 1 Clumps of red-osier dogwood, hoary alder and shad bush at the bases of which, in the moss, the eggs of Hemidactylium are buried. Arrow indicates position of the first lot of eggs found.

Fig. 2 Mass of sphagnum moss opened to expose the eggs of Hemidactylium, which are just below the finger tips of the extended hand.

Plate 2

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Plate 3

Fig. 1 Adult female Hemidactylium scutatum showing typical coloration of the back and sides, the basal constriction of the tail and rudimentary condition of the inner and outer fingers and toes. Actual length of specimen 65 mm.

Fig. 2 Adult female, another specimen, showing basal constriction of the tail which marks the line of separation of the skin in autotomy, and the less-defined depressed line just anterior, the place of detachment of muscles and vertebrae. In this specimen the tail is widest at a point about one-third of its length back of the constriction. The dorsal extensions of the costal furrows meet the median groove at an acute angle. Actual length 73 mm.

Fig. 3 Adult female showing typical coloration of the underparts, the prominent gular fold and the basal constriction of the tail. The length and thickness of the tail is proportionately less than in the specimen (figure 2) figured beside it. Actual length of specimen 62.5 mm.

Plate 3

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Plate 4

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Fig. 1 Eggs of Hemidactylium scutatum, natural size, clinging together and to moss by the adhesiveness of their gelatinous envelops. Photographed with a horizontal camera, the moss being suspended before it.

Fig. 2 A few of the eggs shown in figure 1 enlarged to show gelatinous envelops and the manner in which the outer envelops fuse when the eggs are in contact.

Fig. 3 Dead female, Hemidactylium scutatum, posed on her eggs. The eggs are here considerably more scattered than when found. The basal constriction, gular and dorsal folds are evident.

Plate 3

Plate 5

Fig. 1 Half-grown specimen of Hemidactylium scutatum. exhibiting in its proportions and coloration some of the characters of P. cinereus and indicating the close relation to and derivation from Plethodon. Actual length, 30.4 mm.

Fig. 2 Venter of specimen (figure 1) showing aberrant coloration. The tendency of the pigment spots to coalesce, as here indicated, would if carried farther entirely obliterate the typical coloration of the under sides and give the uniform appearance found in P. cinereus.

Fig. 3 Hemidactylium regenerating the tail. The new stub is at first devoid of pigment but later acquires practically normal coloration. Actual length of specimen, 22 mm.

Plate 5

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Plate 6

Development stages of Hemidactylium scutatum Schlegel

Fig. 1 Medullary folds well formed but nowhere approximated. The earliest stage of development observed in group of eggs taken May 14th.

Fig. 2 Embryo defined on the yolk. Union of medullary folds marked by median depressed line. Same date as specimen in figure 1 but much more advanced in development.

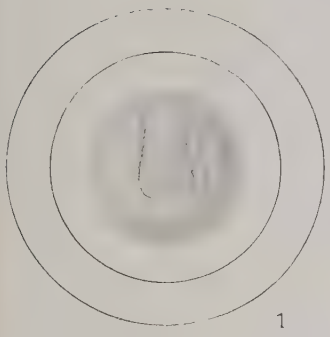
Fig. 3 Segregation of tissue giving indication of position, form and extent of head, gill and body regions. May 16th.

Fig. 4 Limits of head well defined; gill region with large growth of tissue preliminary to actual development of gill and arm buds. Embryo folded upon itself. May 19th.

Fig. 5 Eyes highly pigmented; gill region much thickened and expanded laterally. Three primary divisions of body — head, trunk and tail recognizable. May 21st.

Fig. 6 Embryo slightly more advanced than that in figure 5. Tail distinct from trunk and constriction back of gill region more pronounced. Reduction of yolk mass evident in this and two preceding stages. May 25th.

Plate 6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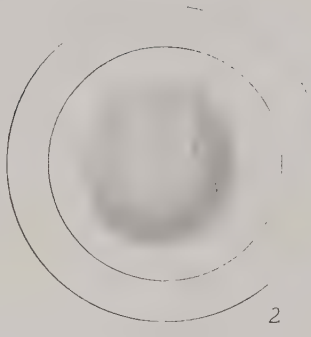
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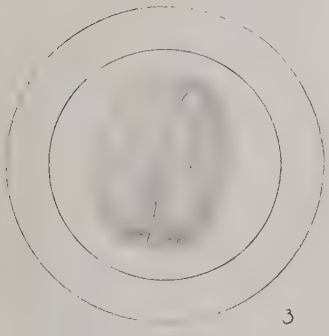
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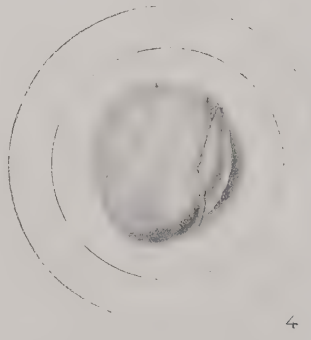
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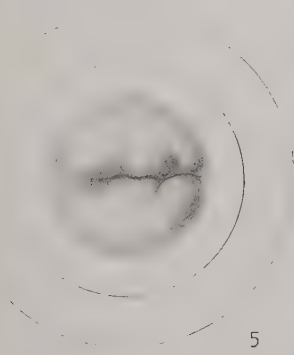
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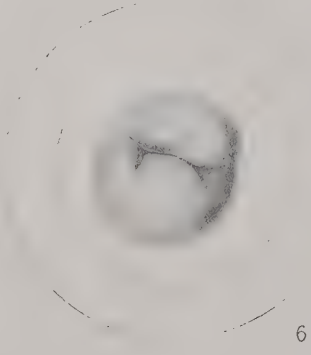
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Plate 7

Fig. 1 Gill and arm buds indicated by lateral depressions; head and tail distinct. Yolk mass confined to region of the lower abdomen. May 27th.

Fig. 2 Three gill buds on right side separate, two on left side and coalesced; arm buds well formed. Pigment in irregularly shaped flecks confined to the back of head, trunk and tail. Embryo active within the gelatinous envelops of egg. Eyes prominent with pupils well developed. June 2d. Length of embryo 7.3 mm.

Fig. 3 Marked development of the gills with indications of fringes. Body compressed back of the head and yolk confined to anal region of abdomen. Color pattern developing along sides of back and tail. June 4th. Length 9.4 mm.

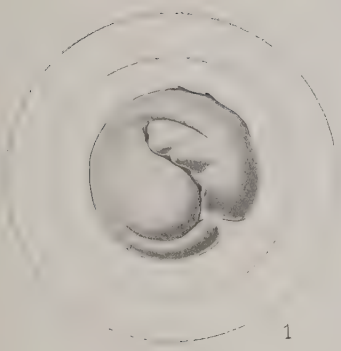
Fig. 4 Gills completely developed and functional; hands with three fingers and legs with indications of developing toes. Color pattern brilliant; light and dark grays predominating with interspersed patches of yellowish green and orange. June 6th. Length 12.6 mm.

Fig. 5 Larva just released from egg envelops. Body and tail compressed and from above, wedge-shaped. Fingers fully developed; toes partly so. Larvae in this stage when placed in water swim freely. June 12th. Length 13.8 mm.

Fig. 6 Reduction of gills 7 days after leaving the egg in larva reared from eggs kept in damp moss. Larva kept in moss saturated with water retained the gills fully developed for 24 days (counting period passed in egg), then died. Adult proportions of body and limbs being acquired in this stage. June 19th. Length 15 mm.

Fig. 7 Detail of gill at height of development showing the two rows of fringe. Direction of flow of blood indicated by arrows.

Plate 7



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THE MOUND BUILDER CULTURE IN NEW YORK

BY ARTHUR C. PARKER, ARCHEOLOGIST

There was a time when western New York was regarded as peculiarly the domain of a mysterious pre-Indian race known as the "Mound Builders."

Observers, astonished by the existence of earth works and other prehistoric tumuli, wrote elaborate descriptions and devoted considerable space to more or less melancholy speculation. The term "Mound Builder" became quite as romantically wonderful in the new world as did that of Druid in the old.

The mounds and earth works of Ohio early attracted interest, and especially as the colonists pushed westward and cleared new land for settlement or agriculture. Thus we find such early authorities as Thomas Jefferson, Benjamin Franklin, President Ezra Stiles of Yale and Noah Webster advancing theories about the builders of the mounds. The first extended discussion on the subject was written by Dr Benjamin S. Barton, who in 1797 published his work on "New Views on the Origin of the Tribes in America." In this work he advanced the theory that the mounds were not built by Indians but by "A people of higher cultivation, with established law and order and a well-disciplined police." Doctor Barton seems to have been the first writer to advance the notion of a "lost race."

Soon after Doctor Barton's book appeared two other writers discussed the subject, Bishop Madison of Virginia and the Rev. T. M. Harris of Massachusetts. Harris thought the mounds proved their builders were of superior skill and of higher civilizations, but Doctor Madison, who had traveled widely and studied the mounds and their antiquities, saw nothing in the evidence to convince him that the mounds were not the product of the Indians. Each of these observers was a pioneer of different schools of belief, but for more than half a century those who believed in "a lost race of civilized men whom the Indians displaced or annihilated" controlled public opinion on the subject. Even today there are many who puzzle over the "mysterious race now departed." J. P. McLean, for example, who in 1879 published his book on "The Mound Builders" commenced his first chapter thus: "An ancient race,

entirely distinct from the Indian, possessing a certain degree of civilization, once inhabited the central portion of the United States."

In his preface he sums up the popular idea in the following: "The mystery surrounding these lost people creates a fascination which is greatly increased in the mind of the student of nature as he lingers among the ruins which invite his attention and rivet his eye. Standing upon one of the monuments the lover of the mysterious will lose himself in meditation. . . ."

Besides the many local antiquarians and historians in New York such men as Henry Schoolcraft, E. C. Squier, Dr E. H. Davis, Franklin B. Hough, T. Apoleon Cheney and Dr Frederick Larkin described, surveyed and speculated upon the earth works of New York.

Wonderful things are ascribed to this ancient race, which is described by the early writers as highly civilized, as making implements better than the Indians possibly could and as erecting earth works that proved them quite familiar with geometry. One writer even pretends to have discovered how the mounds were erected. He claimed to have found a copper tablet having engraved upon it a mastodon in harness.[1] This is said to have been sent to the Smithsonian Institution but it seems never to have reached that place.

Archeologists who have spent many years in excavating mounds and who have studied the problem of the mounds and the builders of the mounds have discovered many facts that prove the fallacy of the old fancies concerning them. Among those who have explored, observed and written in the modern methodological way are Cyrus Thomas of the Smithsonian Institution, William H. Holmes, Lucien Carr, F. W. Putnam of Harvard, William O. Mills of Ohio State University, Warren K. Moorehead of Andover and Clarence B. Moore. Many other investigators have studied the question in the field and after extended scientific observations and by careful comparison have drawn their conclusions. From a lengthy consideration of a wide range of facts we now are warranted in believing the following facts fully established:

1 The builders of the mounds were Indians of certain tribes whose descendants still live.

2 The aboriginal artifacts found in the mounds were made by Indians and no native object found in the mounds differs from

[1] Larkin, Frederick, in "Ancient Man in America." Randolph, N. Y. 1888 8

objects that Indians at the time of the discovery made, or were able to make.

3 Many true mounds of considerable size are not very old but contain in inclusive deposits objects acquired after the coming of the Europeans.

4 Early explorers saw mounds in the course of erection. They have preserved accounts taken from the Indians explaining why and how the mounds were erected.

5 The mounds were not all erected by the same tribe, but by different tribes according to locality.

6 The links connecting the Indians with the Mound Builders are so firmly established by historic and archeologic evidence that archeologists now know them to have been one and the same people.

7 All these conclusions with others are sustained by the explorations conducted by trained observers employed by scientific institutions. The best summary of results is contained in the Twelfth Annual Report of the Bureau of Ethnology, a department of the Smithsonian Institution.

The earth works of aboriginal origin in New York are broadly divisible into two classes: first, walled and trenched inclosures; second, mounds.

With very few exceptions all the fortifications or walled inclosures in New York may be ascribed to the later Algonkian or Iroquoian tribes. These earth works outline retreats or strongholds, and the earthen walls were the bases for stockades. In no sense are these banks and earth walls to be regarded as mounds. None of them was erected by Mound Builders unless we include the Iroquoian tribes as mound building Indians, since the Iroquois did occasionally build low mounds.

In New York the mound builder culture is not always coincident with the presence of mounds. Scattered relics of this culture in the form of monitor pipes, gorgets, banner stones, stone tubes and even isolated burials and stone graves indicate their one-time presence or cultural influence of the " mound building " Indians.

For the purposes of our analysis it is our intention to treat the mounds of New York as one phase of an ethnic culture. We are enabled by this method to treat other evidences of that culture without necessarily confining our descriptions and facts to an immediate association with mounds, though we take our datum from them.

It is not easy to define the boundaries of this culture because the implements and ornaments that it produced in many respects are similar to some of those made by both the Algonkian and Iroquoian

peoples in New York and the adjacent territory, but an examination of the mounds in the western portion of the State gives us certain facts upon which to base our observations. Even in a larger way the Ohio mounds afford us a basis for comparison.

New York mounds and the occupied sites contiguous to them, particularly those in Cattaraugus, Chautauqua, Erie and Livingston counties, indicate that the people of the mound culture used (1) platform pipes, (2) grooved axes, (3) celts, (4) adzes, (5) gouges, (6) gorgets, (7) banner stones, (8) boat stones, (9) birdstones, (10) stone tubes of several varieties, (11) native copper implements and ornaments such as chisels, celts, spear and arrow heads, beads, ear ornaments, etc., (12) numerous flint drills or perforators, (13) shell beads, (14) pearl beads, (15) mica ornaments, (16) bone and antler implements, (17) notched and triangular arrow and spear heads, (18) flints (made in many instances of the Flint Ridge material), (19) made pottery, (20) used discoid stones, (21) concaved disks, (22) used cylindrical and bell pestles, (23) were a village dwelling people, (24) were cultivators of corn, tobacco and other plants, (25) that they buried in small mounds.

The evidences of the mound culture are more numerous in extreme western New York than east of the Genesee river. The culture seems to have entered the State along the shores of Lake Erie and up from the Alleghany river. Chautauqua, Erie and Cattaraugus counties thus contain a larger number of mounds than do other portions of the State, though certain other sections, as the Genesee valley, have yielded relics in abundance.

The regions showing the greatest influence of the mound culture are (1) the south shore of Lake Erie from Westfield to the mouth of Cattaraugus creek, (2) the valley and terraces of the Cattaraugus to Gowanda, (3) the Alleghany valley, (4) the valley of Chautauqua lake and the Chadekoin river, (5) the Connewango valley, (6) the Cassadaga valley, (7) Clear Creek valley, (8) the valley of Buffalo creek, (9) the valley of Tonawanda creek eastward to the overland trails to the Genesee (10) eastward along the Alleghany valley from Bradford northward along the tributaries, thence overland to the Genesee valley, (11) the Genesee valley from Portageville to the mouth of the river, (12) Irondequoit creek, (13) Canandaigua Lake valley, (14) the region of the Finger Lakes, to the Seneca river, (15) the valley of the Seneca river, (16) southward and about the southern shores of Oneida lake, (17) scattering relics along the Oswego river, (18) Jefferson county along the shores of Ontario and the lower waters of the neighboring creeks, (19) the St Lawrence

valley, (20) south of the Finger Lakes, especially along the head streams of the Susquehanna and of the Delaware are scattering relics, (21) portions of the Hudson valley, as near Athens.

Mound Culture Sites

Mounds in New York have had no systematic examinations despite the large amount of work done by amateurs in excavating them. It is safe to say that the possibility of making a methodological examination is now reduced by two-thirds, through the vandalism of inexperienced relic hunters. Many mounds have been scraped down merely to level the ground and others have been scraped into by spade and horse scraper to find what "valuables" they might contain. Few records have been kept and not all that have been made are reliable. Some of the older antiquarians seem to have been highly imaginative. An examination of the most reliable records available to us makes possible the descriptions of the typical mound culture sites given below:

1 Mound on a terrace above the Connewango valley at Poland Center, Chautauqua county. This mound was first described by T. Apoleon Cheney in the Report of the State Cabinet of Natural History (18th Report) for 1860.

When examined in 1905 the mound appeared to have been considerably demolished by excavations, but in size it still remained the highest of which we have any knowledge within the State. It stands several rods back from the edge of the terrace and amid the gloom of a thick forest growth. It still stands 9 or 10 feet in height and with a diameter of about 64 feet. There seem to be the remains of an outer wall and trench surrounding the mound, but the débris from excavations, the deep leaf mould and fallen trees make this difficult to determine. Some fragments of notched flints are to be found in the soil about the mound and it seems to be set in what was once a village site, but on account of the character of the ground this is not easy to establish. Certain it is, however, that the flat land immediately below the terrace shows signs of occupation. Numerous celts, notched spears, soapstone pipe fragments, a beautifully formed stone tube and several gorgets have been found. The culture represented seems similar to that of the Ohio mound area.

It is interesting to note that Cheney claims that eight skeletons buried in a "sitting posture" were excavated from this mound.

Cheney's report on this site in part is as follows:

"The mound indeed, from the peculiar form of its construction, as well as from the character of its contents, has much resemblance

to the barrows of the earliest Celtic origin, in the Old World. In making an excavation, eight skeletons, buried in a sitting position and at regular intervals of space, so as to form a circle within the mound, were disinterred. Some slight appearance yet existed to show that a framework had inclosed the dead at the time of interment. These osteological remains were of very large size, but were so much decomposed that they mostly crumbled to dust. The relics of art here disclosed, were also of a peculiar and interesting character — amulets, chisels &c., of elaborate workmanship — resembling the Mexican and Peruvian antiquities."

2 Burial mound on the south bank of the Cattaraugus creek in Chautauqua county, near Little Indian creek. This is just above the Gold diggings in Indian Mill gulf. The mound is low, not more than 4 or 5 feet in height, though it shows evidence of having been plowed considerably.

It is about 30 feet in diameter. The fields about this mound show evidence of early occupancy, notched points of flint and chalcedony have been found. Several skeletons have been taken from the mound and E. R. Burmaster in 1914 sent the State Museum a fine skull from it. Accompanying relics are recorded to be four notched spears or knives, a copper chisel and a knobbed end lunate banner stone.

The mound stands on the edge of the bluff and a portion has fallen over. Almost exactly north and across the Cattaraugus on the opposite and corresponding terrace are two other mounds. They are reached from the horseshoe bend of the Irving road by taking the road up the hill at this point. Doctor Benedict of Buffalo made some excavations here during 1901. The ground about the mound is strewn with flint chippings and a number of arrow points, celts and a pestle have been found. The excavation from which the earth was taken for building the mound is still visible to the north.

3 Near the mouth of the Cattaraugus on the north side are several large sites each covering from 50 to 100 acres. Several occupations are apparent, but the influence of the mound culture is plainly evident. On the site nearest the mouth of the creek was a mound since removed by the local sand company. It contained skeletons and portions of a Buffalo skull.

The adjacent village site has yielded innumerable notched sinkers, several birdstones, banner stones, celts, gouges, grooved and notched axes. Several broken monitor pipes, one complete form and one clay pipe and several fragments of thick cord stamped pottery were

found by Mr Burmaster. Chipped flints are numerous. The forms are notched arrow points of several types, scrapers, drills, spears and knives. Long flakes of chalcedony and jasper are also found.

4 A mound on a hilltop near Napoli, Cattaraugus county, had within it a stoned-up vault. Some of the flat stones yet remain but the mound has been nearly destroyed. Several gorgets, spears and celts were found within the vault by Dr Frederick Larkin early in the seventies of the last century. Doctor Larkin described the mound to me in 1905. He found human remains in the vault.

5 A mound burial near Tonawanda creek excavated by Jacob Doctor contained a banner stone, a birdstone, a bar amulet and two gorgets. The mound is about 4 feet high, 25 feet in diameter and situated on a gentle slope on the Tonawanda reservation, near Indian Falls, Genesee county. The neighboring fields yield numerous notched flint spear heads and arrow points.

6 An isolated burial near Athens, Green county, and near the Hudson contained a pendant gorget, more than one hundred native copper beads, globular shell beads and pendant columella.

7 On the John F. White estate at Squawkie Hill, Mount Morris, are three low mounds. All contain graves, boxed by stone slabs, the upper edges of which projected above the surface of the ground. These graves contained two highly polished and finely formed monitor pipes, many fresh-water pearls, two copper chisels, a copper double cymbal ear ornament held by hollow copper rivets, two gorgets, two celts and several finely chipped notched spears or knives. In the fields about the mounds have been found numerous flints, many celts and several grooved axes, cylindrical and bell pestles, notched choppers, broken and complete monitor pipes, and one stone pipe bowl. There are numerous other objects, as broken implements, hammer stones, anvils and notched sinkers.

8 Several graves have been found in a gravel bank near Vine Valley on Canandaigua lake. None of the graves was opened by experts and hence there was not opportunity for close observation. The specimens found in the graves, however, are of exceptional interest. From one grave was taken a large tablet gorget, a copper chisel blade, a segment of a mastodon ivory dagger, an antler's awl, a pendant gorget of bone, a bar amulet, a broken bar amulet and two stone tubes. From another grave was taken a stone tube, two long strings of shell beads, and a chipped knife, 10 inches in length. Fragments of a large cord marked pottery jar were found similar to the Irving pottery found by Mr Burmaster.

Most of the objects above described are in the New York State Museum collections, though Mr John F. White has most of the Mount Morris material. Unfortunately the finding of the skeletons in mounds and on mound sites in New York is usually done by those who fail to observe the relation of the specimens to the skeleton. At other times the skeleton is far too greatly decayed to permit any knowledge of the relative position of the object, and therefore a proper conjecture as to the use of the so-called problematical forms.

We are able to state, however, that some of these burials would be considered ordinary in Ohio. The pottery resembles Ohio mound pottery, though no complete vessels have been found. The culture is plainly derived from the Ohio region and southward. Numerous sites along the central Finger Lakes and along the Seneca river have yielded an abundance of polished slates similar to Ohio, Indiana, Michigan and other sections in the mound area. The region about Oneida lake is especially rich. One site near Brewerton has yielded more than twenty copper objects, many gorgets and several banner stones. Mr Bigelow, who had a collection embracing more than ten thousand articles (now in the State Museum), had numerous polished slates from this vicinity.

If we are to trace the route taken by the people of the mound culture we should follow both the lake shore of Erie and the valley of the Alleghany. Perhaps the north shore of Lake Erie was also a route for we find abundance of polished slates in the sites upon which the Huron and the Neutrals and the Iroquois later intruded. The southernmost division in New York, we would say, dwelt about the Chautauqua lake and the valley of the Alleghany, with its tributaries. We thus find true mounds in Chautauqua, Cattaraugus and Erie counties. The southern bands along the Alleghany and the Cattaraugus perhaps found a portage or a short overland trail to the upper waters of the Genesee, and the more northerly along the Tonawanda creek to the lower Genesee. The Genesee valley throughout most of its length is rich in artifacts of this culture, and the routes we have pointed out pass over and through sites where such objects have been found.

Apparently the presence of mounds and the artifacts of the mound culture represent the expansion of the parent culture beyond the limits of its home. Whether this was due to simple migratory movements, to exploring bands, to expatriated tribesmen or the pressure of warring enemies it is difficult to state. Perhaps all these factors contributed to the expansion of the mound culture.

European articles have not been found in undisturbed mounds or ites of this culture in New York. There are, it is true, occasional ntrusive burials in these sites, but all of them appear to be precolonial and pre-Iroquoian. Whether some of them were contemporaneous with an Algonkian culture is another problem. The veight of evidence seems to be that this is the case. Certainly the naterial culture of the eastern Algonkians seems to have been considerably modified by this culture, just as the later New England ribes were modified by the Iroquois. It is quite possible, therefore, hat the mound culture people intruded into the hunting grounds of certain Algonkian bands and established themselves.

The moundbuilding people seem to have disappeared from New York at or before the time of the coming of the Iroquois into their recognized area of occupation. We can not be entirely sure, however, that all were driven out or exterminated. A survey of the earliest Iroquoian sites, especially in western New York, leads us to believe that the earliest Iroquoian immigrants were measurably influenced by the moundbuilding culture. This is so appreciable hat one is led to consider two propositions as within the bounds of possibility: first, that the Iroquois were originally a part of the mound building peoples who had separated themselves from the main cultural body; second, that the Iroquois in entering this region absorbed large numbers of the mound building people and adopted certain of their culture traits and rejected others; third, that the early Iroquois were merely influenced at their early entrance by the mound culture.

Our present knowledge would lead us to conjecture that the Iroquoian hoardes pushing up the Ohio came into conflict with the mound people and finally overcame them. We may then inquire whether or not the Catawba, Tutelo and Saponi do not represent the survivors of these vanquished peoples. We also pause to compare certain artifacts of the Muskoge and early Cherokee with mound objects, as the platform pipe. The earlier Iroquois sites frequently yield, especially in the graves, objects similar to those found in the mounds, but not gorgets, birdstones or related forms. To be explicit, the points of similarity between certain Iroquois forms and mound area forms, as between those of Ripley, N. Y., and Madisonville, Ohio, are certain pipes and certain pottery vessels. A prehistoric Iroquois site at Richmond Mills, N. Y., known as "The Old Indian Fort" has yielded metapodal scrapers, similar in every way to those found in Ohio mound sites. From these facts and from an examination of the entire field of the earlier Iroquoian

occupation in New York and Ontario, we are led to believe that the Huron-Iroquois were the immediate successors of the mound building people in this area. Our belief is confirmed by the abundance of polished slates in Ontario in close proximity to the later Huron-Neutral sites. This fact has confused some archeologists, and led to the statement that the polished slates are Huron or Neutral artifacts, but the graves of the two peoples tell different stories.

The Iroquois once established culturally, did not copy mound artifacts. Indeed, they seem to have deliberately avoided the use of the distinguishing badges of their vanquished foes. Just as the conquerors of the first mound people of Ohio beat up the mica ornaments and hammered into shapeless masses the copper tools and gorgets of their despised victims so did the Iroquois taboo or avoid with deliberateness, the banner stone and the gorget and similar artifacts of polished slate. And do not even civilized peoples in conflict, renounce academic degrees and decorations given by enemies when amity did exist?

Thus we may account for the difference between the pottery, decorative art, implements and earth works of the Iroquois and their predecessors. This difference likewise makes it possible for us to define the polished slate area and fix the limits of the Iroquoian.

One final and important observation remains to be made concerning the similarity of the mound-building people with the Iroquois. The mound-builder and the Iroquoian culture areas adjoin and overlap. These two areas are characterized by the highest artistic development in America north of Mexico, excluding perhaps the northwest coast and the Pueblo areas. The pipes of the mound-builders carved with effigies of animate forms are beautiful specimens of aboriginal art. Many of the carvings are realistic. In the adjoining Iroquoian area, later in its development we find another sort of smoking pipe modeled from clay. On many of these pipes are modeled forms of birds, animals and human figures and faces. The point of essential difference between the pipe art of the mound building Indians and the Iroquois is that the former employed stone and the latter clay. One carved and the other modeled, but each produced the finest types of pipes of their kind and each demonstrated a fine capacity for imitating zoomorphic forms. There is a kinship in this artistic feeling that speaks perhaps of mere contact and perhaps of the closer ties of blood.

New York State Museum

JOHN M. CLARKE, Director

PUBLICATIONS

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The annual reports of the original Natural History Survey, 1837–41, are out of print.

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Paleontologist's annual reports 1899–date.

See first note under Geologist's annual reports.

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Entomologist's annual reports on the injurious and other insects of the State of New York 1882–date.

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9	.25	20 (" 97)	.40	30 (" 180)	.50
10	.35	21 (" 104)	.25	31 (" 186)	.35
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12	.25	23 (" 124)	.75	33 (" 202)	.35

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Bound also with museum reports 21-date of which they form a part; the first Botanist's report appeared in the 21st museum report and is numbered 21. Reports 21–24, 29, 31–41 were not published separately.

Separate reports for 1871–74, 1876, 1888–98 are out of print. Report for 1899 may be had for 20c; 1900 for 50c. Since 1901 these reports have been issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have also been published in volumes 1 and 3 of the 48th (1894) museum report and in volume 1 of the 49th (1895), 51st (1897), 52d (1898), 54th (1900), 55th (1901), in volume 4 of the 56th (1902), in volume 2 of the 57th (1903), in volume 4 of the 58th (1904), in volume 2 of the 59th (1905), in volume 1 of the 60th (1906), in volume 2 of the 61st (1907), 62d (1908), 63d (1909), 64th (1910), 65th (1911), v. 2 of the 66th (1912) reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared, constitute Museum Memoir 4.

Museum bulletins 1887–date. 8vo. *To advance subscribers, $2 a year, or $1 a year for division* (1) *geology, economic geology, paleontology, mineralogy* 50c *each for division* (2) *general zoology, archeology, miscellaneous,* (3) *botany* (4) *entomology.*

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1 Zoology
2 Botany
3 Economic Geology
4 Mineralogy
5 Entomology
6 "
7 Economic Geology
8 Botany
9 Zoology
10 Economic Geology
11 " "
12 " "
13 Entomology
14 Zoology
15 Economic Geology
16 Archeology
17 Economic Geology
18 Archeology
19 Geology
20 Entomology
21 Geology
22 Archeology
23 Entomology
24 "
25 Botany
26 Entomology
27 "
28 Botany
29 Zoology
30 Economic Geology
31 Entomology
32 Archeology
33 Zoology
34 Geology
35 Economic Geology
36 Entomology
37 "
38 Zoology
39 Paleontology
40 Zoology
41 Archeology
42 Geology
43 Zoology
44 Economic Geology
45 Paleontology
46 Entomology
47 "
48 Geology
49 Paleontology
50 Archeology
51 Zoology
52 Paleontology
53 Entomology
54 Botany
55 Archeology
56 Geology
57 Entomology
58 Mineralogy
59 Entomology
60 Zoology
61 Economic Geology
62 Miscellaneous
63 Geology
64 Entomology
65 Paleontology
66 Miscellaneous
67 Botany
68 Entomology
69 Paleontology
70 Mineralogy
71 Zoology
72 Entomology
73 Archeology
74 Entomology
75 Botany
76 Entomology
77 Geology
78 Archeology
79 Entomology
80 Paleontology
81 Geology
82 "
83 "
84 "
85 Economic Geology
86 Entomology
87 Archeology
88 Zoology
89 Archeology
90 Paleontology
91 Zoology
92 Paleontology
93 Economic Geology
94 Botany
95 Geology
96 "
97 Entomology
98 Mineralogy
99 Paleontology
100 Economic Geology
101 Paleontology
102 Economic Geology
103 Entomology
104 "
105 Botany
106 Geology
107 Geology and Paleontology
108 Archeology
109 Entomology
110 "
111 Geology
112 Economic Geology
113 Archeology
114 Geology
115 "
116 Botany
117 Archeology
118 Geology
119 Economic Geology
120 " "
121 Director's report for 1907
122 Botany
123 Economic Geology
124 Entomology
125 Archeology
126 Geology
127 "
128 "
129 Entomology
130 Zoology
131 Botany
132 Economic Geology
133 Director's report for 1908
134 Entomology
135 Geology
136 Entomology
137 Geology
138 "
139 Botany
140 Director's report for 1909
141 Entomology
142 Economic Geology
143 " "
144 Archeology
145 Geology
146 "
147 Entomology
148 Geology
149 Director's report for 1910
150 Botany
151 Economic Geology
152 Geology
153 "
154 "
155 Entomology
156 "
157 Botany
158 Director's report for 1911
159 Geology
160 "
161 Economic Geology
162 Geology
163 Archeology
164 Director's report for 1912
165 Entomology
166 Economic Geology
167 Botany
168 Geology
169 "
170 "
171 "
172 "
173 Director's report for 1913
174 Economic Geology

175 Entomology
176 Botany
177 Director's report for 1914
178 Economic Geology
179 Botany
180 Entomology
181 Economic Geology
182 Geology
183 Geology
184 Archeology
185 Geology
186 Entomology
187 Director's report for 1915
188 Botany
189 Geology
190 "
191 "
192 "
193 "
194 Entomology
195 Geology
196 Director's report for 1916
197 Botany
198 Entomology
199 Economic Geology
200 Entomology
201 Economic Geology
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203–204 Economic Geology
205–206 Botany
207–208 Director's report for 1917
209–210 Geology
211–212 "
213–214 "
215–216 "
217–218 "
219–220 Director's report for 1918

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12–15	48, v. 1	78	57, v. 2	117	60, v. 3	165–67	66, v. 2
16, 17	50, v. 1	79	57, v. 1, pt 2	118	60, v. 1	168–70	66, v. 1
18, 19	51, v. 1	80	57, v. 1, pt 1	119–21	61, v. 1	171–76	67
20–25	52, v. 1	81, 82	58, v. 3	122	61, v. 2	177–80	68
26–31	53, v. 1	83, 84	58, v. 1	123	61, v. 1	181	69, v. 2
32–34	54, v. 1	85	58, v. 2	124	61, v. 2	182, 183	69, v. 1
35, 36	54, v. 2	86	58, v. 5	125	62, v. 3	184	69, v. 2
37–44	54, v. 3	87–89	58, v. 4	126–28	62, v. 1	185	69, v. 1
45–48	54, v. 4	90	58, v. 3	129	62, v. 2	186	69, v. 2
49–54	55	91	58, v. 4	130	62, v. 3	187	69, v. 1
55	56, v. 4	92	58, v. 3	131, 132	62, v. 2	188	69, v. 2
56	56, v. 1	93	58, v. 2	133	62, v. 1	189	69, v. 1
57	56, v. 3	94	58, v. 4	134	62, v. 2	190	69, v. 2
58	56, v. 1	95, 96	58, v. 1	135	63, v. 1		
59, 60	56, v. 3	97	58, v. 5	136	63, v. 2	*Memoir*	
61	56, v. 1	98, 99	59, v. 2	137, 138	63, v. 1	2	49, v. 3, and 50, v. 2
62	56, v. 4	100	59, v. 1	139	63, v. 2	3, 4	53, v. 2
63	56, v. 2	101	59, v. 2	140	63, v. 1	5, 6	57, v. 3
64	56, v. 3	102	59, v. 1	141–43	63, v. 2	7	57, v. 4
65	56, v. 2	103–5	59, v. 2	144	64, v. 2	8, pt 1	59, v. 3
66, 67	56, v. 4	106	59, v. 1	145, 146	64, v. 1	8, pt 2	59, v. 4
68	56, v. 3	107	60, v. 2	147, 148	64, v. 2	9, pt 1	60, v. 4
69	56, v. 2	108	60, v. 3	149	64, v. 1	9, pt 2	62, v. 4
70, 71	57, v. 1, pt 1	109, 110	60, v. 1	150–54	64, v. 2	10	60, v. 5
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74	57, v. 1, pt 2	113	60, v. 3	161	65, v. 2	12, pt 2	66, v. 3
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INDEX

Albany county, notes on local floras, 238
Algal balls, 16
Anomalina, 186
  grosserugosa, 187
Apple maggot, 78
Archeologist and Ethnologist, report, 99–120
Armstrongia, a new genus of Devonian glass sponges, 143–46
Attendance, 10

Bagg, Rufus Mather, Foraminifera of the Bonaventure cherts of Gaspé, 149–204
Bird reservations, 18
Bishop, Sherman C., Notes on the habits and development of the four-toed salamander, Hemidactylium scutatum, 251–82
Bolivina, 164
  dilatata, 165
  punctata, 166
Bonaventure cherts of Gaspé, Foraminifera of, 149–204
Bonaventure conglomerate microscopic fauna, 147–48
Botanist, report of, 32–36; reprint of report for *1886,* 36–75
Bulimina, 161
  pupoides, 161
  pyrula, 162
Bunaia, a new merostome crustacean, 129–34
Bunaia woodwardi, 134
Bunodes lunula, 134

Chemical and mineralogical investigations, 30–31
Chimney Island, St Lawrence river, 18
Clark reservation near Jamesville, 16
Clarke, John M., Postbellum reflections on the place of Paleontology among the sciences, 123–28; New Paleozoic crustaceans, 129–42; Armstrongia, a new genus of Devonian glass sponges, 143–46; Microscopic fauna of the Bonaventure conglomerate, 147–48
Clarke, Noah T., Reconstruction of the Sterlingbush calcite grotto, 223–26
Codling moth, 77
Cornplanter, Chief Edward, death of, 104–5
Cornplanter medal, 107
Cristellaria, 172
  acutauricularis, 172
  gibba, 173
Crustacea, from the Permian of São Paulo, Brazil, 135–42
Crustaceans, new Paleozoic, 129–42
Cryptozoon ledge near Saratoga, 16

Devil's Pulpit, 17
Devonian crinoids, monograph of, 29
Dewey collection, 100–1
Discorbina, 182
  orbicularis, 183

Education Building, discoloration of façade, 10–11
Entomologist, report, 77–86

Felt, E. P., Insects and the state, 227–31
Fenno, Frank E., Plants of the Susquehanna valley and adjacent hills of Tioga county, 247–50
Field crops, injury to, 80
Field operations, additions to collections from, 13–14
Fishes, collections, 13
Foraminifera of the Bonaventure cherts of Gaspé, 149–204
Forest tree pests, 80
Fossils, invertebrate, restorations of, 13
Frankfort faunas, 28
Fruit tree insects, 77
Fungi, collection of, 33; notes on, 233–37

Gall insects, 83
Gampsonyx brasilicus, 137
Gaspé, Foraminifera of the Bonaventure cherts, 149–204
Genesee county, notes on local floras, 238
Geological survey, report on, 22–31
Glass sponges, Armstrongia a new genus of, 143–46
Globigerina, 178
aequilateralis, 179
bilobata, 179
bulloides, 180
var. triloba, 180
cambrica, 181
cretacea, 181
didyma, 182
Gloniopsis gloniopsis, 235
Grass and grain pests, 79
Greene county, notes on local floras, 241

Helminthosporium pedunculatum, 234
Hemidactylium scutatum, notes on the habits and development of, 251–82
Henry, Joseph, proposed statue, 14–15
Herkimer county, notes on local floras, 240
House, Homer D., Notes on fungi, 233–37
Hughmilleria phelpsae, 213

Industrial geology, 25–28
Insects and health, 80–82
Insects and the state, 227–31

Lagena, 166
globosa, 167
laevis, 168
marginata, 169
Legal status and scope of State Museum, 9
Lighting, improved, 10
Little Duck Island, Maine, 19–20
Local floras, notes on, 238–46
Lophiotrema peckiana, 234
Lorraine faunas, 28
Lyon Mountain Quadrangle, 22–25

Madison county, notes on local floras, 241
Map of the State, proposed, 22
Miller, William J., report on Lyon Mountain Quadrangle, 22–25
Mineral production, 27–28
Mineral resources, report on, 25–26
Mineralogist, report of, 30–31
Mixopterus multispinosus, 208–13, 218–22
Monroe county, notes on local floras, 242
Morchella angusticeps, 237
Morgan, Lewis Henry, centennial, 105–7
Mound builder culture in New York, 283–92
Museum collections, increases and changes in, 11–12
Mycena atkinsoni, 233
filopes, 233
Mycological herbarium, 33
Mycosyrinx osmundae, 235

New Brunswick, list of Foraminifera identified in the Bonaventure cherts, 191–92
New York State Archeological Association, 107–8
Newland, David H., Industrial geology, 25–28
Nodosaria, 170
communis, 170
radicula, 171
soluta, 171
Nursery inspection, 85–86

Oneida county, notes on local floras, 244
Onondaga county, notes on local floras, 245
Ontario county, notes on local floras, 245
Orbulina, 176
ovalis, 177
porosa, 177
universa, 178
Oswego county, notes on local floras, 246

Paleontology, 28–30; postbellum reflections on place among the sciences, 123–28
Parker, Arthur C., The mound builder culture in New York, 283–92
Paulocaris pachecoi, 135–36
Pear psylla, 79
Pear thrips, 79
Pittsford shale, a recurrent Pittsford (Salina) fauna, 205–22
Polymorphina, 173
communis, 174
compressa, 175
gibba, 175
Polyporus elegans, 237
Pterygotus? vernonensis, 214
Publications, 21
Puccinia cephalanthii, 236
commutata, 236
fraxinata, 236
lobeliae, 235
lysimachiae, 236
minutissima, 237
orbicula, 237
pustulata, 236
pyrolae, 235
rhamni, 235
Pulvinulina, 187
boueana, 188
elegans, 188
micheliniana, 189

Red bugs, 78
Rhizopogon luteolus, 234
rubescens, 234
Rotalia, 190
orbicularis, 190
Ruedemann, Rudolf, A recurrent Pittsford (Salina) fauna, 205–22

Salt investigation, 27
San José scale, 78
Scientific reservations under control of the Museum, 16–20
Sclerothamnus clausi, 146
Seneca Indian Monument at Canandaigua, 20
Septameroceras chadwicki, 207
Silenite, term, 23
Silica for glass and refractories, 26–27
Squaw island, 16
Staff of Department, 121–22
Stark's Knob volcano, 16
State Museum, legal status and scope, 9
Stereum willeyi, 237
Sterlingbush calcite grotto, reconstruction of, 12–13, 223–26
Susquehanna valley, plants of the valley and adjacent hills of Tioga county, 247–50

Textularia, 155
gibbosa, 155
globulosa, 156
gramen, 157
pupa, 157
trochus, 158
Truncatulina, 183
boueana, 184
lobatula, 185
ungeriana, 185
Tussock moth, white-marked, 78

Uromyces silphii, 235
spartinae, 236
Ustilago bipustulata, 235
Utica faunas, 28

Valvulina, 159
sp. 159
Verneuilina, 160
pygmaea, 160
Vernon shale, notes on fossils of, 207–22
Virgulina, 162
sp. 164
schreibersiana, 163
squamosa, 164
subsquamosa, 164

Water-biscuits, 16
Wayne county, notes on local floras, 246

Zoologist, report, 87–98